RADIO CRAFT

HUGO GERNSBACK, *Editor*

IN THIS ISSUE—NEW!

FM Station List

BRUNETTI WRIST-WATCH TRANSMITTER

SEE PAGE 28

The ONLY
Complete Servicing Reference
on ALL Pre-War and Post-War Receivers

25% More Listings
Than the
5th Edition

Accurate
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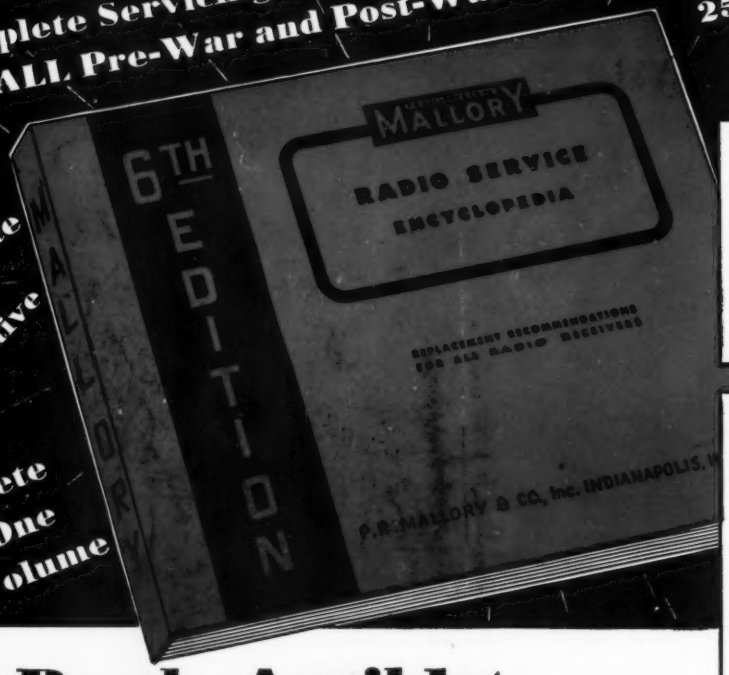
Complete
in One
Volume



SALES of previous editions offer the best evidence of its worth.

Edition	*Year*	*Copies sold*
1st	1937	51,000
2nd	1938	25,000
3rd	1939	55,000
4th	1941	60,000
5th	1946	75,000

Here's what you get:

- Data on correct replacement parts
- Circuit information
- Servicing hints
- Installation notes
- IF peaks
- Tube complements and number of tubes
- References to Rider, giving volume and page number

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RADIO-CRAFT, April, 1948, Volume XIX, No. 7. Published monthly by Radcraft Publications, Inc., 29 Worthington Street, Springfield 3, Mass. Entered as second class matter at Post Office, Springfield, Mass., under the Act of March 3, 1879.

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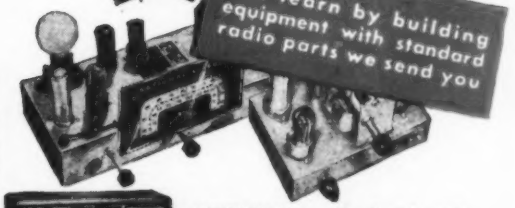
Make More Money in Radio TELEVISION & ELECTRONICS NOW!

You build this fine modern Superheterodyne Receiver and other units, with the complete standard parts we send you. This valuable equipment becomes yours to use and keep.



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If you are already employed in the great Radio industry, you know how great the demand is for trained, experienced servicemen, operators and technicians. You know how fast the field is growing and how important it is to keep up with new developments in F.M., Television and Electronics. The Radio industry is alive with opportunity for the qualified technician whose knowledge is **up-to-the-minute.** You can be an FM and Television specialist . . . get into the lucrative Radio Service Field . . . own a business of your own, if you prefer. National Schools of Los Angeles, for over 40 years a practical resident and home study trade school, has put into effect its New 1948 Training Program. This program, adapted to National's Master Shop Method Home Study Course, can qualify you in your spare time as a Radio and Television technician. For details of this Program fill out and mail the coupon below.

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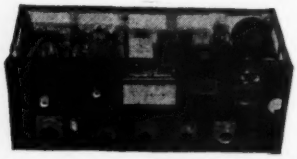

RADIO ALTIMETER APN/1

A complete 460 mc. radio receiver and transmitter which can be converted for ham or commercial use. Tubes used and included: 4-12SH7, 3-12SJ7, 2-6H6, 1-VR150, 2-955, 2-9004. Other components such as relays, 24 V dynamotor, transformers, pots, condensers, etc., make this a buy on which you can not go wrong. Complete as shown in aluminum case 18"x7"x7¼.

$8.95

NAVY CRV-46151 AIRCRAFT RADIO RECEIVER

INCLUDING CASE

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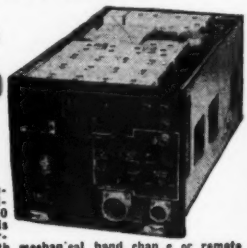

Four bands, including broadcast (195-9,050 KC). Circuit is six-tube superheterodyne with mechanical band change or remote operated electrical band change. Remote band change and tuning controls included, making this set readily adaptable to mobile ham use. Powered from self-contained 24 V. DC dynamotor.

The sets are complete with tubes, mounting rack and remote controls. No tables or prods.

AIRCRAFT TRANSMITTER BC-457A or BC-458A

Ideal to make over for master oscillator. Priced complete with tubes. Has built-in crystal for dial calibration. Used but in good condition. 5.3-7 MC or 4-5.3 MC FREE Mounting Rack with order of two or more.

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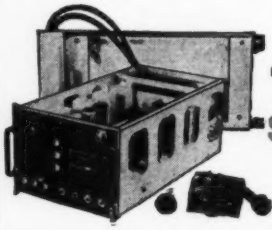
ARC-4 TRANSMITTER & REC.

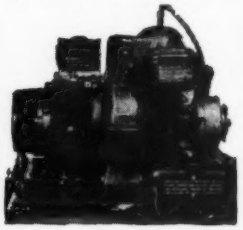


INCLUDING CASE

$17.95

Operates on any of its 4 predetermined crystal controlled frequencies in the range of 140 MC. Complete with tubes, remote control, junction box, shock mounting base and connecting plugs. This unit is ideal for amateur UHF or mobile telephone. Operates from self-contained 24 V DC dynamotor.

(HRU) DC POWER SUPPLY



24-28 V. at 70 amp. 2000 watts gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V. equipment, start airplane engines, charge batteries, as a welding machine, lighting system, or for amateur radio station. 21½", 17½" x 24⅝". Wgt., 115 lbs.

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Includes 20 ft. plug-in cable.

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Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore-bearing rock, the location of metallic fragments in scrap materials, logs, etc., and the screening of personnel in plants for carrying of metallic objects. New, complete in original overseas packing container. Originally sold by War Assets for $166.00. The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

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SCR-274N COMMAND SET

SCR-274N Transmitter and Receiver Assembly consists of 13 pieces which are: 4 dynamotors, 1 modulator, 1 remote control box, 2 transmitters, 3 receivers and one antenna relay unit and it has its own individual dynamotor. Each receiver employs 12 V. tubes. Each transmitter contains four 12 V. tubes and has a variable frequency and crystal calibrated master oscillator, driving two 1625 final amplifier tubes, 55-watt output, with built-in silver plated variable inductance antenna matching device. Oscillator and final stage have simultaneous tuning and the dial is directly calibrated in MC. Transmitters have slugged and capacity tuning, built-in high voltage and antenna switches. Modulator furnishes plate supply for transmitters and is equipped with a dynamotor for high voltage. Also supplied is one antenna relay with built-in antenna meter. Transmitters make ideal VFO driver unit. Easily converted to 110 V. 60 cycle operation. Wt., approximately 100 lbs.

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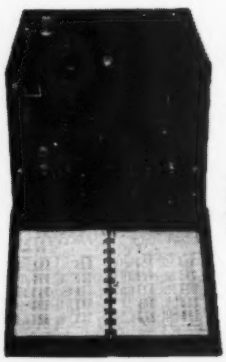

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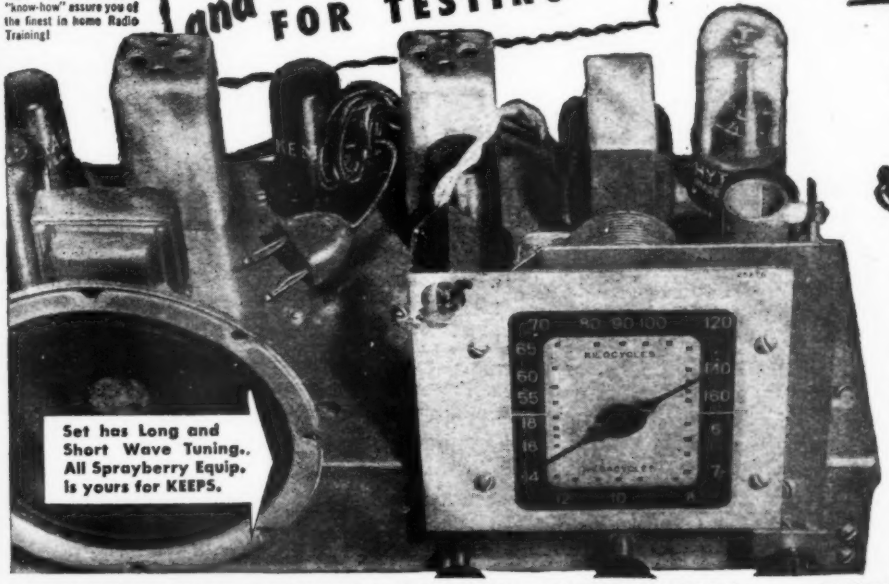
YOU GET 8 BIG KITS OF RADIO PARTS & EQUIPMENT including 2-BAND SUPER RECEIVER!

and 16 RANGE METER FOR TESTING



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You Learn at Home How to Build and Test Dozens and Dozens of Circuits — Simple and Complex!

YOU DO OVER 175 INSTRUCTIVE EXPERIMENTS

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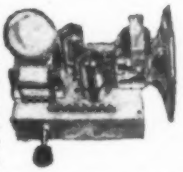
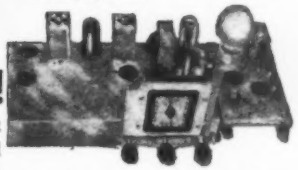
I give you a fine, moving-coil type Meter Instrument on Jewel Bearings — with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional speed and accuracy.



You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on ready-made Equipment.



Soldering, wiring, connecting Radio parts . . . building circuits with your own hands — you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

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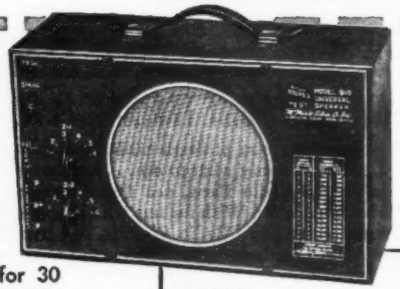
ONLY $44.50 NET

2 NEW FM & TV SWEEP SIGNAL GENERATOR

FM and TV are here — must be serviced by every technician today. Model 909 and any good 'scope does the TV and FM alignment job — visually — easily — simply — perfectly — and fast. Three bands 2 thru 266 mc., linear electronic sweep panel variable from 40 kc. to 10 mc. It's no wonder Model 909 — first announced in late January — is the "hottest" instrument in radio. Model 909 is another "must" for every service laboratory — new Silver inventions make it newest and by far the best. With complete instructions.

ONLY $48.50 NET

3 NEW MODEL 910 UNIVERSAL TEST SPEAKER



Six-inch high-quality PM speaker and 8 watt *truly universal* output transformer of the new "SPARX" give you any transformer impedance, single or push-pull, from 325 thru 70,000Ω. Panel jacks and switches permit combined or independent use of transformer and/or high-quality 6" PM (3Ω voice coil) speaker. Chart on panel instantly shows correct switch positions for 30 different impedances — can't get lost. Size and style matches "VOMAX", 906 FM/AM Signal Generator — all SILVER LCETI.

ONLY $22.70 NET

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SEND FOR COMPLETE CATALOG. See these and Silver communication transmitters, receivers, "Micromatch", TV preamplifier, pretuned freq. multiplier at your jobber.

OVER 37 YEARS OF RADIO ENGINEERING ACHIEVEMENT

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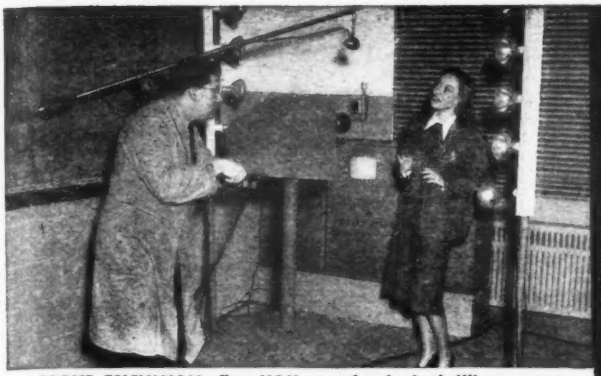

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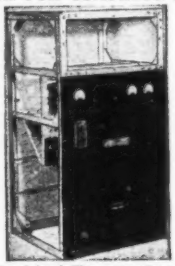

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(Magnetrons)

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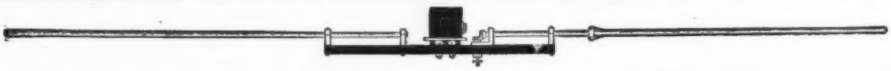
2J22	3267-3333 mc.	265 Kw.	$15.00
2J26	2992-3019 mc.	275 Kw.	$15.00
2J27	2965-2992 mc.	275 Kw.	$15.00
2J32	2780-2820 mc.	285 Kw.	$15.00
2J38	PKG. 3249-3263 mc.	5 Kw.	$25.00
2J55	PKG. 9345-9405 mc.	50 Kw.	$25.00
3J31	24,000 mc.	35 Kw.	$17.50
W.E. 700-A	680-710 mc.	100 Kw.	$35.00
W.E. 720BY	2800 mc.	1000 Kw.	$25.00

MAGNETS for 2J21-A(725-A), 2J22, 2J26, 2J27, 2J31, 2J32 and 3J31, each.....$8.00

Field Strength Gauss	Distance Bet. pole faces	Pole Face Diameter	Price
4850	5/8"	3/4"	$ 8.00
1500	1½"	1⅝"	$ 8.00
1000	Adjustable		
(Electromagnet)	2⅜" to 3"	2½"	$12.00
2100	1⅛"	¾"	$ 4.00



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#5102: 1080 vct @ 55 ma, 6.3 v. @ 1.3 amp, 6.3 v. @ 1.2 amp.....$2.35
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No. 5080: 6.3 V NCT @ 6A, 6.3 V NCT @ 1.5 A $1.40
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.045 mf @ 2000 VDC, type G1.....12.75
.00015 mf @ 20 KV, type 1970-404.....25.00
.0001 mf @ 20 KV, type G3.....25.00
.0051 mf @ 15 KV, type G4.....25.00
.006 mf @ 10 KV, type G3.....17.50
.002 mf @ 15 KV.....20.00

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3BP1—$1.25 ..... 5FP7—$1.75
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ANTENNA, AN/122-A. Used in 4-element adcock arrays for high gain and directivity, each dipole element is 12' long, made of ¾" tubing. Excellent for that new 6 or 2-meter beam. Don't miss this great value.
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ANTENNA AN/104-A. The famous Ax-handle antenna, used with the SCR 522. Ideal for mobile quarter wave, because of its streamline construction; or 2 units can be used to form a dipole for 2 meters or for TV and FM reception. Consists of copper sheath 21" long moulded about a wooden support, with 83-1R coax connector.....$.75 ea., or 2 for $1.35

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DM-42: In 14VDC. Out 515/1030 VDC 215/260 ma and 2/8VDC.....$3.95

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CONVERSION COILS FOR ARC-5 TRANSMITTERS

M.O. Coils	P.A. Coils	Antenna Loading Coils	Freq. Range
$1.00 each	$1.00 each	$.85 each	
#6029	#7247	#6033	3-4 Mc.
#6030	#9293	#6034	4-5.3 Mc.
#6032	#9295	#6035	7-9.1 Mc.

CONVERSION KIT, consisting of 1-M-O coil, 1-P.A. coil, 1-ANTENNA COIL, in any one particular frequency range $2.00
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ARC No. 4990. variable xmtg. capacitor, 22.4-145 mmf. .05" spacing, 11 rotors. Each.....$1.00
ARC 5032 Var. Xmtg. capacitor, 29.2—117 mmf. .06" spacing, 16 rotors, worm drive: 96:1 .....$1.00
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Dual mtg. racks (revr.) $1.50
Shock mounts for rack .....$ .50
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355-A . . . $4.50 **705-A . . . $1.25**

1619's — 6L6 with 2.5 V. Filament — 5 for $1.00

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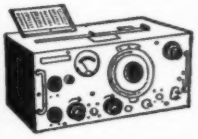

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AMPHENOL LOW-LOSS SERIES CONNECTORS

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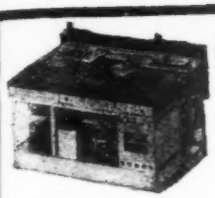

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The famous SCR 522 Radio Transmitter and Receiver, for operation on the 2 meter band (100 to 156 M.C.), is now available, complete with all 18 tubes in EXCELLENT condition at an unbelievably low price. This set is easily converted to 6 meter operation, if you prefer.

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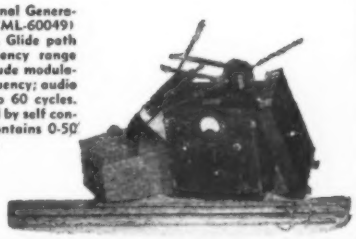

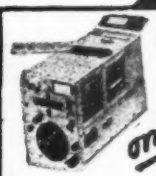

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908	1.50	7 CP 1	3.25
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In An Early Issue

MYSTERY RADIO RELAY
DOUBLE-BRIDGE VOLTMETER
WIND-DRIVEN GENERATORS

On the Cover:

Dr. Cledo Brunetti's wrist-watch-radio, as worn by Miss Dorothy S. Dowling, a Bureau of Standards employee, Washington, D.C.

Chromatone by Alex Schomburg from Harris & Ewing photo.

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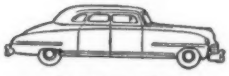

A New Car

Greater Security

Happy Vacations and Travel

Jobs worth $3000 to $7500 are opening up right now for FCC Licensed Radiomen

How to Pass FCC Commercial Radio Operator LICENSE EXAMS

GET YOUR FCC TICKET IN A FEW SHORT WEEKS

Get your license easily and quickly and be ready for the $3000 to $7500 jobs that are open to ticket holders. CIRE training is the only planned course of coaching and training that leads directly to an FCC license.

IT'S EASY WITH CIRE COACHING AND TRAINING

Your FCC ticket is recognized in all radio fields as proof of your technical ability. Employers often give preference to license holders, even though a license is not required for the job. Hold an FCC "ticket" and the job is yours!

I can train you to pass your FCC License Exams in a few short weeks if you've had any practical radio experience — amateur, Army, Navy, radio servicing or other. My time-proven training plan can help put *you*, too, on the road to success—

EDW. H. GUILFORD, Vice-President.

Let me send you FREE the entire story

Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam and Catalog A, describing opportunities for you in Radio-Electronics.

Get All 3 FREE Send Coupon Now!

Look what these students say:

"Thanks to this course, I now have a very good job in a local power plant's test department. I couldn't have obtained this job without the math and basic electrical theories in the first part of Section I of this course." Stud. No. 2893N12

"I have been working for Police Radio Station WPFS in Asheville for five months since getting my second-class ticket." Stud. No. 2858N12

"You may be interested to know that I am employed at the local broadcast station, where I am a transmitter operator. I took and passed the FCC examinations last February." Stud. No. 2754N12

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RC-4 Terminal Tower, Cleveland 13, Ohio

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The battle of the atoms

Telephone equipment is constantly at war against invisible forces of nature which seek to take it apart, atom by atom. On all fronts, Bell Laboratories chemists must fight corrosion — an enemy able to make a telephone circuit noisy or perhaps to sever it altogether.

An example: for years lead cable had lain protected in wooden ducts. Then in certain areas something began to eat the sheath, exposing wires to moisture. Corrosion chemists of the Laboratories were called in. The corrosion, they found, came from acetic acid generated in the wood during the preservative treatment then in use. They pumped in neutralizing ammonia. Corrosion stopped. Now telephone duct wood is controlled for acidity.

In a large city, smoke-polluted air was coating the silver surfaces of contacts with sulphide. Noisy circuits resulted. Chemists discovered minute traces of sulphur vapor in the air. They filtered incoming air with activated charcoal. Today, the latest telephone contacts are of palladium — not affected by sulphur.

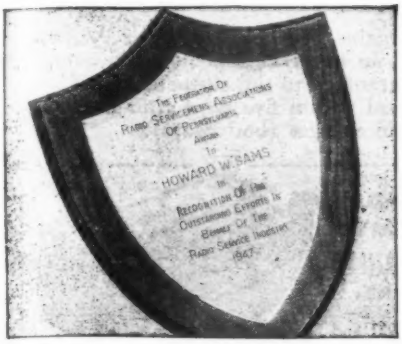
Corrosion in metals is only one type of deterioration which engages Bell chemists against hostile forces. Plastics, paper, metals, rubber, textiles, coils, waxes and woods all have enemies. But knowledge, and persistence, are steadily winning out—to the benefit of the telephone user.

A Bell Laboratories corrosion engineer examining samples during an exposure test on corrosion-resistant finishes and alloys.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

HOWARD W. SAMS WINS "OSCAR" FOR AID TO RADIO SERVICE INDUSTRY!

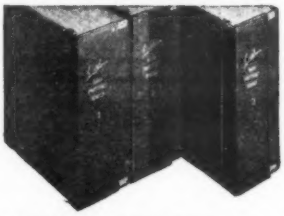


The handsome plaque awarded to Howard W. Sams carries the inscription: "The Federation of Radio Servicemen's Associations of Pennsylvania Award to Howard W. Sams in Recognition of His Outstanding Efforts in Behalf of the Radio Service Industry, 1947." The award is a tribute to the practical usefulness of PHOTOFACT Publications—the world's finest radio service data—indispensable to the Radio Serviceman.

PHOTOFACT Publications Cited as Outstanding Effort in Behalf of Servicemen

"For Outstanding Efforts in Behalf of the Radio Service Industry"—reads the citation of the first annual award bestowed on Howard W. Sams by the Federation of Radio Servicemens' Associations of Pennsylvania. The "Oscar" was presented before a group of over 600 persons, including many radio industry leaders, at a banquet held on January 12, 1948, at Philadelphia's Bellevue-Stratford Hotel. The surprise ceremony was arranged as a demonstration of appreciation for the significant, practical aid made available to Radio Servicemen in PHOTOFACT Publications, and for the efforts of the SAMS' organization in behalf of the Radio Service Industry. This spontaneous demonstration marks a milestone in the Radio Service field. It is a healthy sign of growing recognition of the Serviceman's importance to the Radio Industry.

These Are the Award-Winning Service Aids that Earn More Money for You!



Own PHOTOFACT Volumes 1, 2 and 3—world's most complete, accurate, practical radio service data manuals. Here is everything you need for faster, easier, more profitable servicing—bound in easy-to-use volumes. Exclusive Standard Notation Schematics; photo views keyed to complete replacement parts lists; exhaustive electrical and mechanical analysis of every set covered. Brings you right up to January 1948! Have the exclusive advantages that are now earning bigger profits for thousands of servicemen!

Vol. 1. All post-war models up to Jan. 1, 1947.
Vol. 2. Models from Jan. 1, 1947 to July 1, 1947.
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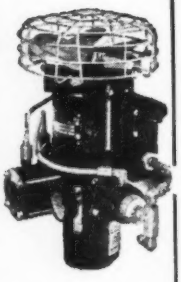
ESSE Specials!

Do not fail to closely examine this list of bargains. We believe that every item listed below is a sensational value that soon can never be repeated. All equipment advertised herein is unconditionally guaranteed to the customer's satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).

WALKIE TALKIE

BC 222 and BC 322 — Frequency 27.7-52.2 Mc. using 2 oscillator coils—52.8-65.8 Mc. using 1 oscillator coil. Crystal calibrator used to select amplitude modulated channels at every 400 Kc of separation. Uses one type 30 and type 33 tube.

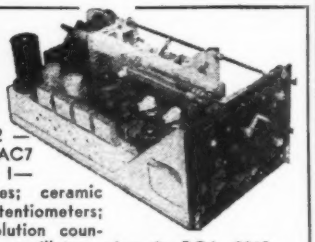
$39.50



AIR COMPRESSOR

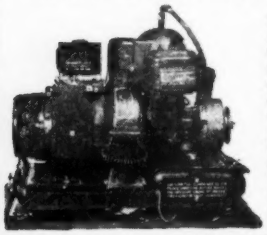
Made by General Electric Co. Will pump pressure up to 1000 lbs. per sq. in. 2-stage type—air-cooled, powered by a 24 V. DC motor. Ideal in shop for use with airgun, small paint sprayer, and numerous other applications. Small, compact, precision - built. Only **$12.95**

RADAR XMTR T-39/APQ-9

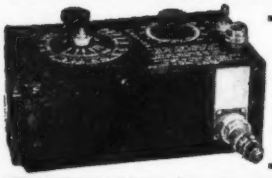


Contains 2 — 807's, 2—6AC7 1—931 and 1—6AG7 tubes; ceramic switch; potentiometers; gears; revolution counter; Cavity oscillator using 2—RCA 8012 tubes rated at full output to 500 Mc. (tubes are forced air-cooled by 24 V. DC motor—easily converted 110 V. AC operation); a goldmine of parts for the VHF experimenter. Price **$12.50**

(HRU) DC POWER SUPPLY



24-28 V. at 70 amp. 2000 watts gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V. equipment, to start airplane engines, to charge batteries, as a welding machine, lighting system, or for an amateur radio station. Height, 21½"; Width, 17½"; Length, 24½", and weight, 115 lbs. **$72.50**

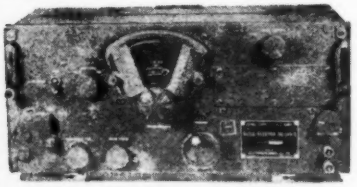


INTERVALOMETER

Electronic timing device. Was used for releasing bombs at intervals. Ideal for darkroom timer, model train controller. (Contains relays, switches, pilot light, resistors, knobs, etc.) **$2.25**

TELRAD 18-A FREQUENCY STANDARD

Checks signals in the range of 100 Kc. to 45 Mc. with a high degree of accuracy. Self-contained power supply for 110, 130, 150, 220, and 250 V. 25-60 Cy. AC. Complete with tubes, dual crystal, and instruction book. Brand new. One of the best buys on the surplus markets. **$24.95**



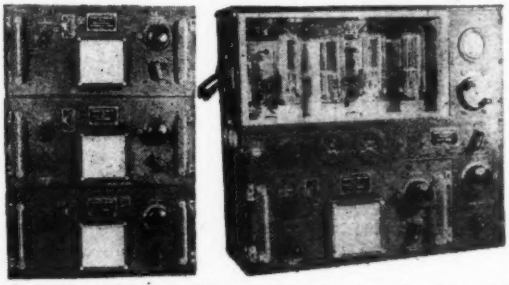
BC-348 COMMUNICATIONS RECEIVER, $69.50

6 bands, 200-500 Kc. and 1.5-18 Mc. 2 stages RF, 3 stages IF, BFO, crystal filter, manual or AVC. Complete with tubes and 24 V. dynamotor. These receivers have been thoroughly checked in our workshop and found in excellent condition.

BC-348, 110 V. AC power supply, including simple conversion instructions. Complete with tube...$8.95

BC-375 MOPA TRANSMITTER

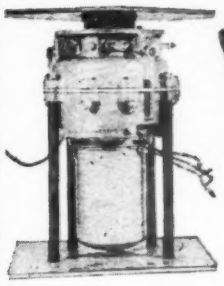
A really fine buy!



The most famous of all surplus transmitters. Was used by the Army bombers and ground stations during the War. Frequency range is covered by means of plug-in tuning units as shown below. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. FREQUENCY RANGE: 200-500 Kc. and 1500-12,500 Kc. (Will operate on 10 and 20 meter band with slight modification.) OSCILLATOR: self-excited, thermo-compensated, and hand calibrated. POWER AMPLIFIER: neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Dynamotor which furnishes 1000 V. at 350 Ma. CONVERSION instructions and diagram for 110 V. AC furnished upon request for $1.00.

PRICES: As follows—

Transmitter only	$12.50
Tuning units TU-5B, TU-6B, TU-7B, TU-8B, TU-9B, TU-10B, TU-26B, choice..	$2.50
Dynamotor PE-73C	$3.95
Antenna tuning unit (BC-306A)	$4.95



ROTATOR MOTOR FOR YOUR BEAM ANTENNA

$9.95

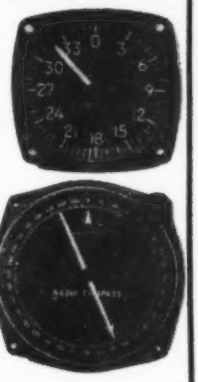
24-32 V. AC or DC operated. Reversible—only 3 wires required. Approximately ¾ RPM. 7056 to 1 gear reduction (no free swing). Powerful motor. Rugged precision gear train, and sturdy thrust bearing—will support and turn any ham beam. Weather-proof housing. Motors are easily converted into an FB beam rotator! Conversion data included. $9.95

MOTOR WITH ANTENNA MOUNTING PLATES WELDED ON.....$6.00 extra

SELSYN TRANSFORMER FOR SELSYN INDICATORS, 110 V. AC input, 25 V. AC output $2.75

TRANSFORMER FOR BEAM MOTOR, 110 V. AC input, 2-12 V. Secondary windings. Rating 11 amps.....$4.95

Selsyns Indicators



For use with beam rotators for indication of direction of beam. Operate from 15-24 V. 60-cycle AC supply Wiring instructions.

Large Model 5" diameter **$2.85**

Small Model 3" diameter **$2.89**

AIRCRAFT RADIO RANGE FILTER FL-8-A

For helpful reduction of QRM on crowded CW bands. When attached to output of any communications receiver:

1—Will pass signal of 1020 CPS, eliminating others.

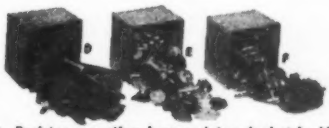
2—Will pass voice frequencies and eliminate 1020 CPS code signal.

Compact, light weight, with switch. Size 2¾"x2⅜"x3¾". Price 2.25

A—Resistor kit composed of 150 or more assorted wattages. Containing various resistors of up to 10 megohms. Many with gold bands. An honest-to-goodness bargain.....Box 2.65

B—Condenser Kit. Contains assortment of 25 various condensers including 2-2Mfd. 600 V. filters, 1-1000 Mfd. 15 V. filter 4-1 Mfd. 400 V. paper by-pass, 3-3 gang midget trimmers, etc.....2.65

C—Hardware Kit containing about 5 lbs. of radio hardware including nuts, bolts, washers, shafts, gears, grommets, lugs, screws, spacers. It is a gold-mine of invaluable parts.....1.95



D—Resistor mounting lugs and terminal strip kit. Assorted sizes and shapes. Many, Many, Many 1.00

E—Tube Socket Kit. 25 or more assorted sockets having various usable sizes.....1.50

F—Switch Kit consisting of assortment of 10 rotary and toggle switches. Price.....1.25

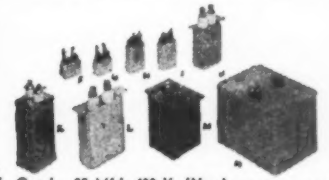
A—Cond. (Solar) 10 Mfd. 1000 V. (New).....2.00

B—Cond. (GE Pyranol) 8 Mfd. 1000 V. DC (New).....1.75

C—Cond. (Chi. Ind. Cond. Corp.) 4 Mfd. 2000 V. (New).....2.50

D—Cond. (Cornell-Dubilier) 1 Mfd. 4000 V. (New).....3.00

E—Cond. (Chi. Ind. Cond. Corp.) Dual 8.5 Mfd. 1000 V. (New).....3.50



F—Cond., .25 Mfd. 400 V. (New).....10

G—Cond., .125 Mfd. 400 V. (metal cased) (dual condenser) (New).....15

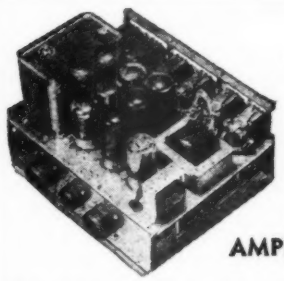
H—Cond., 1.75 Mfd. 50 V. (New).....15

J—Cond. (GE Pyranol) 2 Mfd. 600 V. (New) .50

L—Cond., 4 Mfd. 600 V. DC (GE Pyranol) (New) .50

M—Cond., 4 Mfd. 300 V. (New).....35

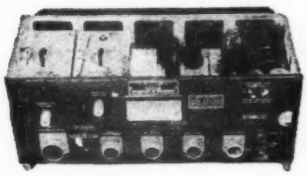
N—Cond., 30 Mfd. 330 V. AC (GE Pyranol) (New).....3.00



C-1 AUTO AMPLIFIER

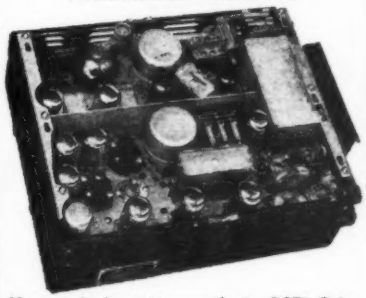
Were used to control operation of Servo-units, causing them to move the control surface of airplane in one direction or the other in response to signals received. The complete amplifier includes one rect. 7Y4, 3—7F7's for amplification and control, 3—7N7's for signal discrimination, 1 power transformer, 6 relays, 4 control pots, chokes, condensers, etc. Convert for use on radio controlled models, doors, etc. Operates from 24 V. DC. Size 9¼x6¼x7⅝". Complete **$6.95**

APN-1 RADIO ALTIMETER



A complete 460 Mc. radio receiver and transmitter which can be converted for ham or commercial use. Tubes used and included: 4-12SH7, 3-12SJ7, 2-6H6, 1-VR150, 2-955, 2-9004. Other components such as relays, 24 V. dynamotor, transformers, pots, condensers, etc., make this a buy on which you cannot go wrong. Complete as shown in aluminum case 18" x 7" x 7¼". **$8.95**

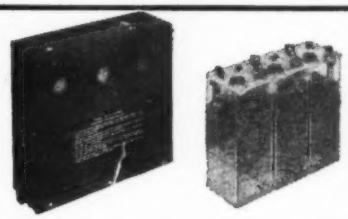
BC-645 Ultra Hi-Frequency Transmitter-Receiver



You read about it recently in QST! Originally operated in the frequency band from 450 to 500 Mc. Can be converted to 420 Mc. amateur band. Consists of complete transmitter and modulator system, and receiver. Instructions for conversion to AC supply.

Complete with 15 tubes..... **$11.95**

BRAND NEW



6 V. (New) (Dry-charged).....$3.00

6 V. (In metal carrying case) (Add electrolyte specific gravity 1.265) (Drugstore) 4.00

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Your business, too, is built on *customer confidence!* And your reputation is too valuable to risk with inferior or unknown products. The cost of the parts you use in the average repair job is insignificant compared with your investment in *your reputation.*

That's why we say—YOUR CUSTOMERS AND *YOUR REPUTATION CAN AFFORD ONLY THE BEST!* . . . SPRAGUE.

CAPACITORS **SPRAGUE** *KOOLOHM RESISTORS

* T.M. Reg. U. S. Pat. Off.

SPRAGUE PRODUCTS COMPANY, North Adams, Mass.

JOBBING DISTRIBUTING ORGANIZATION FOR PRODUCTS OF SPRAGUE ELECTRIC CO.

Reach for a SPRAGUE and Know You're Right!

The superiority of the new Sprague type TM High-Temperature Molded Paper Capacitors didn't happen by chance. You can use this better unit in your work today only because of more than four years of intensive research and one of the largest retooling programs in Sprague's history. That's why we can say *"The First Truly Practical Molded Paper Tubulars are Sprague TM's"*—and it is also the reason you can *use them on any job* with confidence and pride.

- **Highly Heat Resistant**
- **Moisture Resistant**
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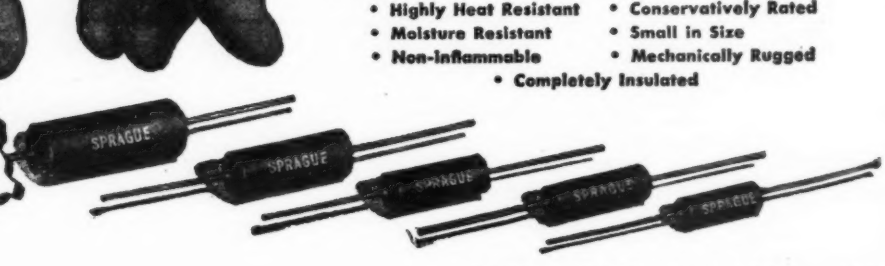
- **Conservatively Rated**
- **Small in Size**
- **Mechanically Rugged**
- **Completely Insulated**

UNCONDITIONALLY GUARANTEED!

You can stake your reputation on Sprague replacement parts. If used at rated capacitance and voltage, they are UNCONDITIONALLY GUARANTEED to give satisfactory performance. Insist on Sprague and get the best!



RADIO AS A VOCATION*

The radio-electronic field is more lucrative than ever.

By HUGO GERNSBACK

IT IS estimated from best available sources that the radio industry as a whole today employs no less than one hundred and fifty thousand** men in all its branches.

This includes everybody, from the lowest-paid radio assembler girl up to the highest-paid radio executive. In between, we run the entire gamut of all classes of radio men and *the classification of all of them would take more space than this printed page!*

The young man eager to enter the radio field today has a tremendous field before him with numerous branches of the industry from which to choose. Each succeeding year, new subdivisions of the various branches are being added and the field constantly expands and keeps enlarging. The major branches of radio today may be roughly summarized as follows:

Radio set manufacturing, radio tube manufacturing, radio parts manufacturing, television, general electronics, radio broadcasting, radio servicing; and a great many minor branches.

I constantly receive letters from young men who write to me that they "wish to get into the radio game." As a rule, the writers do not state their qualifications or their educational background, and it is almost impossible without closely questioning the subject, to determine just where he will fit in best. It is useless to speak in generalities to these people without having made a careful survey of their mental equipment. One man might fit in well as a serviceman and might make a success of it, while the same man as a research engineer or broadcasting engineer would be totally unfit. For this reason, it is impossible to give hard and fast rules, it being impracticable for the outsider to arrive at any definite conclusion.

We cannot all be radio executives or research engineers of high order. We may not have the right mental equipment for this. In many ways, the college graduate who has taken up electrical engineering is fitted for an entirely different capacity than the man who has only a high school education; but, of course, there are exceptions. Some of our best radio executives have had no college education. Here then, again, the mental equipment and other educational background play a big role. No two cases are ever alike for two men. No two men will react exactly alike; neither will their likes be exactly the same; nor will they fit into the same positions equally well.

There is, however, a general rule—that may be summarized in *one word*—which the young man who wishes to enter the radio industry should be told about. In the first place, what are his personal likes in the matter? What are the goals he is striving for? Some men who wish to reach the top do not care how low they start; anything that comes along will be taken as the first rung of the ladder to be climbed. Others have fixed ideas as to what they wish to tackle. My own recommendation to would-be aspirants to a position of importance in the radio industry has always been expressed in one word—*"Specialization."*

What the radio industry of today needs more than anything else is specialists in the various branches. There are too many half-baked, irresponsible young men who just hold down jobs and never get anywhere. These form by far the largest percentage of the total manpower of the radio industry. *It is the minority who specialize, and who, as a rule, get somewhere.*

And it makes little difference in this respect whether they are college graduates or not. Of course, if you can afford to go through college and take the various courses (always provided that you know how to take advantage of the teaching offered at college), you will emerge from college with a first-class background which will enable you to "go places" in the radio industry. By far, the greater majority of young men, however, are not so fortunate. They find it necessary to earn a living after they leave high school. A large proportion of these either take a good radio correspondence course or visit a resident school for a number of months. Others, who cannot afford this, get their entire knowledge from practical work in the field and from radio books and publications. In the end, it all amounts to the same thing. If they have the correct mental make-up, it will get them just as far with one type of education as with another—and often the self-taught man has been able to go as far as the college graduate. Edison, for instance, never had better than a high school education, *(Continued on page 81)*

RADIO-CRAFT continues to receive many letters from young men eager to make radio-electronics their profession. For them and untold thousands we reprint on this page an editorial first published in the November, 1935, issue of RADIO-CRAFT.

What was written then applies even more truly today. Since World War II the radio-electronics field has grown to undreamed-of proportions. The estimate of 265,000 radio-electronic technicians in all the various branches today is a conservative one. The number still grows by leaps and bounds year after year.

*Reprinted from November 1935 RADIO-CRAFT.
**Corrected estimate, as of 1948, 265,000.

RADIO-ELECTRONICS

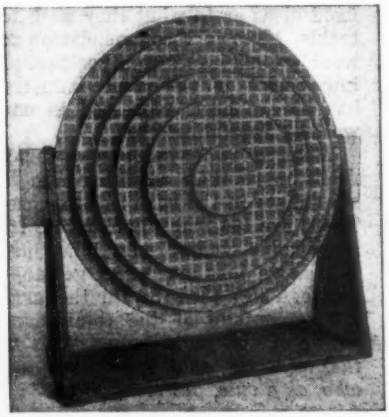
BROAD-BAND METAL LENS which can theoretically handle from 50 to 100 television channels or tens of thousands of simultaneous telephone messages was announced last month by Dr. Winston E. Kock of Bell Laboratories.

The new lenses are based on the theories of light transmission through atomic and molecular structures; in fact, one type of the new lens looks somewhat like a model of a crystalline molecule shown in almost any physics textbook.

One such lens consists of an array of metallic spheres. The radio waves, in passing through the lens, set up electric currents in the spheres and thereby produce the same effect on the radio waves that the molecular lattices of a glass or crystalline lens produce on light waves.

Thus the new lenses are built by scaling up (increasing the size of) the molecular lattice structure of a dielectric or non-conductor, such as glass, and then substituting electrically conductive elements for the molecules. These elements need not be spheres but can be small strips of conducting material, such as aluminum or copper foil.

The earlier metallic lenses were constructed of rows of conducting plates



This "printed circuit" metal lens is made of tin squares sprayed onto polystyrene sheets.

and operate on wave-guide principles which *speed up* the radio waves as they pass through the lens. In the new type lens, the wave is *slowed down* as in an ordinary glass lens. Dr. Kock and his associates have demonstrated that lenses constructed on this principle can be used over a much wider band of wave lengths.

One lens, for example, could be effective at all microwave lengths between a half-inch and four inches. Such a lens could theoretically handle 50 to 100 television channels. Available techniques limit present lenses to only eight such programs in the relatively narrow wave length band between three and three and one-half inches.

It had been known for some time that glass lenses could focus microwaves just as they focus light waves. But such lenses would have to be so big and so heavy that they are completely impossible for radio relay applications. Such a lens might be 10 feet in diameter and weigh several tons.

Then the thought occurred to Dr. Kock that if the lattice structures which are believed to constitute atoms and molecules could focus light waves, a scaled-up or magnified model of such a lattice structure would also focus electro-magnetic or radio waves of correspondingly scaled-up wave length.

Since even the very short radio waves known as microwaves are 100,000 times longer than light waves, a scaling-up of the molecular model by that ratio produces a lens which can focus microwaves.

TELEVISION interference must continue with the prospect of blotted-out and disrupted picture reception if present-day television-receiver standards and frequency assignments are not changed, the engineering staff of the American Radio Relay League testified at a special hearing of the Federal Communications Commission last month.

At the hearing, which was held mainly to consider rearrangement of the present television frequency channels, ARRL representatives cautioned against continuation of frequency assignments that invite technically unavoidable interference, not only from amateurs but also from police and fire-department radio, mobile telephone circuits, industrial users, and diathermy installations in hospitals and doctors' offices.

LARGEST TELEVISION studios in the world are being constructed in New York City by the Columbia Broadcasting System, Frank Stanton, president of the network, announced last month.

Mr. Stanton said that the studios will occupy more than 700,000 square feet of space and will be in operation by April.

A RADAR-PROOF container for air shipment of photoflash bulbs was announced last month by Sylvania Electric Products, Inc.

The new development is aimed at protecting air shipments of the bulbs from ignition by radar. It has been found that under certain conditions radar may set off the flash bulbs.

The radar-proof canister resembles containers used to hold perishable food.

MOVIEGOERS in 1975 will be able to watch events as they happen anywhere throughout the world with the aid of guided missiles and television, Eric Johnston, president of the Motion Picture Association, predicted last month.

He envisaged planetarium-type theaters in which "the audience will sit around a circle and watch the action being produced on a giant dome . . . instead of on a flat screen."

Mr. Johnston explained that guided missiles travelling at a speed which could take them around the earth in two and a half hours would carry pickup equipment to transmit these images in full color.

TELEVISION set owners in New York, Philadelphia, and Chicago are only lukewarm toward the television programs they now receive, but eager for a pay-as-you-see system that will telecast first run movies, Broadway plays, and other costly entertainment features unavailable on free television.

These facts were determined by a survey just completed by William Bethke, educational director of LaSalle Extension University in Chicago.

The survey, he reports, covered 9,341 television set owners in New York, Philadelphia, Chicago, and adjacent areas. Letters were sent to television set owners with return postcards for answering two questions: First: Was the set owner satisfied with the television programs he now receives. Second: In addition to free programs would he be willing to pay a reasonable fee for home viewing of first-run movies, Broadway plays, newsreels, and championship sport events not available on free television. The return figures show that 76% of the set owners in Connecticut, 64% in New York, 52% in New Jersey, 70% in Chicago, and 49% in Philadelphia would be willing to pay for programs.

FACSIMILE BROADCASTING on a large scale by FM broadcasters has its first indication in a letter filed with the Federal Communications Commission by the FM Association last month.

Filed in protest against proposed rates for 15,000-kc circuits for FM networks, as submitted by the American Telephone and Telegraph Co., the FMA letter claimed that the transmission of programs and facsimile simultaneously over the same circuit is possible, but that restrictions by AT&T would preclude duplexing of programs and facsimile.

Rates proposed for FM network facilities are approximately double those for ordinary radio networks, according to the FM Association.

REVISION OF RULES governing the operation of low-power oscillators is being considered, the Federal Communications Commission announced last month. This low-power equipment includes devices ranging from phonograph oscillators to carrier-current transmitters.

This announcement was made because of the apparently increasing general interest in such apparatus. It is intended to "sound a note of caution" to present and prospective users and manufacturers of devices which operate within such rules.

FACSIMILE EDITIONS of the *New York Times* were transmitted last month in a large-scale demonstration of this service. The material was written by the staff of the newspaper and transmitted over WQXR-FM. The editions had four pages 11½ inches long and 8 inches wide.

MONTHLY REVIEW

RADAR SIGNALLING for the Chicago elevated transit lines was proposed in a report submitted to the Chicago Transit Authority committee by Captain William C. Eddy last month.

In operation, a transmitter on the front of the train sends out a signal which is reflected back to a receiver by a special reflector on the rear end of the train ahead. If there is a safe distance

How the proposed radar system will operate.

between the two trains, an automatic computor lights a green lamp on the engineer's control panel. An unsafe distance between the trains causes a red lamp to glow. If the distance between the trains becomes dangerously short, the train brakes lock automatically to prevent a crash.

COMPLAINTS by customers against radio repairmen have been greatly exaggerated in radio and newspaper reports, the newly-organized Association of Radio Servicemen of New York City discovered last month.

Aroused by widespread accounts of malpractice by radio repairmen, the Association offered to handle complaints from any radio owner who had suffered at the hands of any unscrupulous radio servicemen. The offer was publicized widely in the city newspapers.

Two weeks after the notice was issued only 20 complaints had been received, 17 of which were settled immediately. During the same period—unexpectedly—more than 30 requests for service were made. These were referred to the Association member nearest each job. Thus favorable reactions outweighed unfavorable ones by 50%. A further 16 requests for advice were also classed as favorable

GOVERNMENT CONTROL of broadcasting in Argentina was protested in a letter from the Inter-American Association of Broadcasters to the president of the Argentine Congress last month. The letter is the result of a study made by the IAAB on the Argentine Congress' proposal to turn over the control of broadcasting stations to the government.

A report filed with the letter states that during 1947 many stations were closed and licenses cancelled. It also protested against the government practice of ordering stations to drop regular schedules for a broadcast in the political interest of the government.

SHORTWAVE HEATING and blasts of dry air are now being used to kill the larva inside silkworm cocoons. This new method, the Japanese silk industry claims, produces a silk as tough and durable as synthetic fibers.

Silkworms were formerly killed by plunging the cocoons into boiling water and drying them with hot air. The new electronic process avoids the intense heat which it is believed to reduce the tensile strength of the old product.

DR. W. R. G. BAKER of the General Electric Company was elected vice-chairman of the Electrical Standards Committee of the American Standards Association at a meeting in New York City last month. He will serve as chairman of the communications and electronic section.

Dr. Baker's appointment by the ASA is expected to give the radio and electronic industry greater representation in the national standardization work.

A 5,280-MILE conversation on microwaves was made last month at an alumni meeting at the Massachusetts Institute of Technology. This call set a record for long-distance microwave transmissions. In the call, the voice of Paul M. Byle, engineer for the Bell Telephone Laboratories, made 12 round trips on the microwave circuit between Boston and New York.

This transmission climaxed a demonstration by engineers of the Bell Laboratories and the American Telephone and Telegraph Company. The demonstration also included calls to an automobile, a trawler at sea, to Nantucket Island and Hawaii.

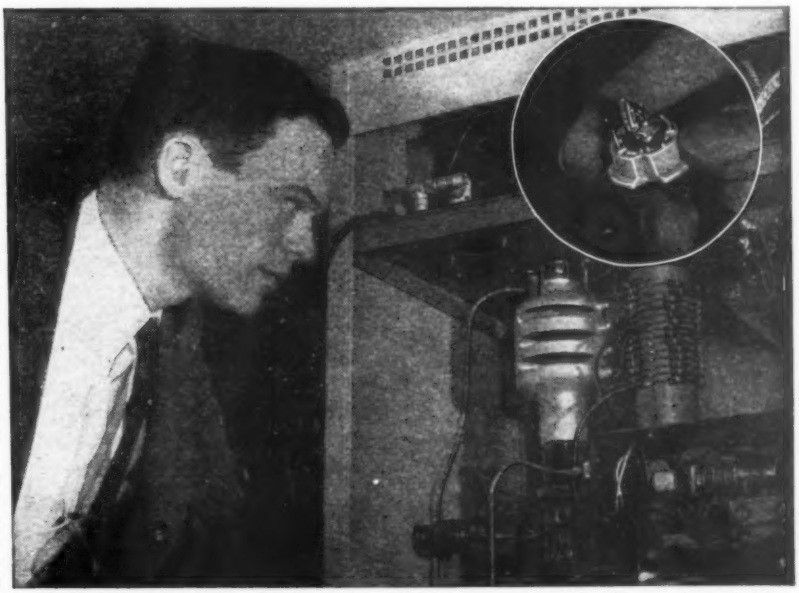
AMPLIFICATION with a diamond rather than the conventional vacuum tube was announced by Bell Laboratories last month. The method is based on the discovery that when beams of electrons are shot at an insulator—in this case a diamond chip—electric currents are produced in the insulator which may be several hundred times as large as the current in the original electron beam.

The process itself is somewhat similar to the technique of translating the energy of a beam of light into electricity which underlies the operation of the well-known photoelectric cell.

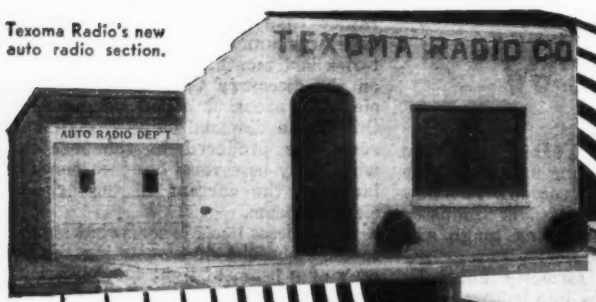
One of the major difficulties encountered came when the Bell physicists found that as the current started to flow in the diamond chip, the electrons became trapped in the tiny imperfections which are present in all crystals. Thus, after the first fraction of a second, the induced current wasted away under the opposition of the trapped electrons.

To overcome this, the investigators applied an alternating voltage to the diamond chip so that current flowed through the diamond one way for a fraction of a second and then in the other direction, reversing itself 120 times a second. Alternately negative and positive charges are drawn through the crystal and some of each kind are trapped. The trapped positive charges cancel out the effect of the trapped electrons, or negative charges, and the induced current is allowed to flow freely.

The experiments stemmed directly from previous pioneer research in which current was induced in diamonds by bombarding them with alpha particles. This earlier investigation promises development of a new laboratory tool for counting alpha particles. It would do essentially the same thing as the familiar "Geiger counter." The new device, however, would have smaller size, lower operating voltage and a faster counting rate.


Dr. McKay of Bell Labs with diamond amplifier equipment. Insert: diamond in its holder.

Texoma Radio's new auto radio section.



By C. J. WHITTON

Interior view of the new auto radio repair department and part of main radio repair section.

The Radioman Expands His Business

SHOULD we expand? Do we actually need more floor space and facilities? Will our business continue to warrant an expansion that is apparently needed at this time? This is a problem that many a radioman has to meet at one time or another in his career. We at Texoma were recently confronted with these perplexing questions and our answer was an emphatic *Yes*.

In arriving at this conclusion we did not consider our past success nor did we rely upon our own judgment as to what the future might bring. The answer to these first two questions were found in our own business records. For the first, many valuable outside sources of information were called upon to give us a definite answer. These sources of information are available to any business, whether it be large or small, and the data that may be had for the asking in all probability took months to compile and represents several million dollars spent on research. These silent partners of your business are glad to help you and you can be sure that the information they give you will be to your advantage because they stand to lose or gain with you.

At the head of our list of information sources is our banker. A word here in regard to the part your banker should play in your business will not be amiss. Handle all of your transactions by check. By depositing your entire shop income and making all payments by check, you have created two assets to your business. You have secured an indisputable receipt for payments made, and you have placed at the disposal of your banker a complete financial record of your firm. He can study this record and tell you more about your financial condition than you can. Remember, too, that if your decision is to expand your business, in all probability you will have to call upon this banker for that little financial boost that will be needed in most cases. The advice you receive from him will be based on the outlook for several years to come, for it would be foolish for him to invest money in your business on the prospects of a few months.

Our next source of advice is our jobbers and suppliers. They too stand to lose or gain by your decision. Business done with your main suppliers should be handled on an open account basis when possible. This again accomplishes two things. It gives you an established credit rating which, if properly handled, is another valuable asset. Second, your jobber can at a glance determine from your ledger sheet the direction of your buying trend. This when coupled with the trend of his area will help him in advising you. Remember that the business trends of localities are often misleading, so rely upon someone who already has this cross-sectional information. It will save you lots of time and trouble.

Our final questions were placed with our local business associates: our hotels, garages, theaters, and managers of large chain concerns. Here again we receive an unbiased opinion because each fellow's business is dependent upon another's success.

Our answers: From the banker,

(Continued on page 74)

A New Year and New Links
In Our Chain of Improvements!
Interior View of Texoma Radio Co., Featuring the Recently Completed Car Radio Service Department
To a Greater Growing Denison!
As the old saying goes, "A chain is no stronger than its weakest link"—we believe that business must be founded on the satisfaction of customers who are the links that make progress in business possible.
In less than two years we have undergone two major expansion programs, adding new installations, space and equipment to better serve our customers, who have made our anticipated growth a realization.
Our friends and customers and their splendid reception of the services that we have to offer are wholly responsible for the expansion programs we have been able to complete.
We want to sincerely thank every citizen of this community and promise them a guaranteed service on all repair work that we are privileged to do for them.
Texoma Radio Co.
"COMPLETE RADIO AND APPLIANCE REPAIR SERVICE"
126 West Chestnut
Phone 2630

An excellent example of how the radio technician can use advertising.

Standard Television Sets Become Projectors

LARGE-SCREEN television is a treat for which we will have to wait for some years, say the engineers of some of the biggest radio and television companies. Serviceman and engineer William Spellman refuses to look at the problem so patiently and philosophically, and has produced his own large-screen television here and now. He has custom-engineered a large number of ordinary television receivers to work with a large screen, and is now —in co-operation with Colonial Television Co. of the Bronx, New York— selling such sets to points as far away as Los Angeles.

Mr. Spellman's system is simple. He installs a high-voltage, projection-type tube in place of the regular viewing tube of a standard televiser, provides a 30-kilovolt r.f. power supply for it, and mounts a projection lens ahead of the tube. The lens is adjustable to focus on a screen, which can vary in size up to 6 x 8 feet with excellent definition, and may be as large as 12 x 16 feet where especially large pictures are required.

The high-voltage power supply, shown in Photo 1, is a standard r.f. job with a pair of 6Y6's as oscillators and three 8016/1B3 rectifiers in a voltage-tripling circuit. The high-voltage portions of the circuit are all mounted on Lucite, as may be seen from the photograph.

An ordinary low-voltage power pack supplies power to the oscillator tubes. The 2 sections of the new pack are mounted in the lower half of a wheeled cabinet, in the top half of which the televiser is installed.

Photo 2 shows a top view of this top compartment as seen through a removable center panel in the top of the cabinet. The high-voltage, projection-type television tube has ample room in the space occupied by the original 10- or 12-inch viewing tube, even with part of the lens assembly ahead of it. The lens itself, together with the viewing tube, is shown in Photo 3. It is manufactured especially for television projection by Bausch and Lomb.

Mr. Spellman has found that, though a standard televiser will produce satisfactory projection images, it is advisable to modify the video amplifiers if very large screens are to be used. Improved contrast and definition result, he claims.

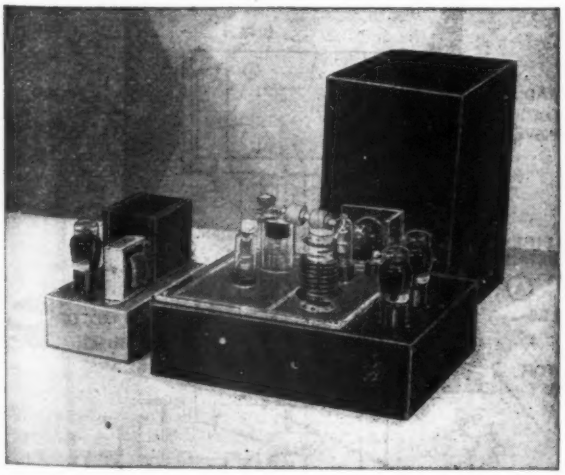
Not a large number of sets have been produced up to the present, and the demand has been such that Mr. Spellman has found it expedient to accelerate his operations through combining with the Colonial Television Co. to turn out a larger number. Most of his sets are being used by theaters or exhibitors, and of course in bars and grills. The largest audience recorded was at the Shriners' Auditorium in Los Angeles, where 4,800 people viewed a program projected on a 12 x 16-foot screen. Reception, according to *Billboard* magazine, was quite satisfactory.

Operation of the projection televisers is as simple as that of any other type of television receiver, the only additional adjustment being that of the optical lens, which must be focused on the screen like a home movie projector.

It is expected that kits for converting ordinary televisers to large-screen machines will be made available to experimenters. The cost will not be low—totaling something over $300. This would make the conversion more attractive for commercial than home use, though no doubt many experimenters would be interested.

Colonial President Emerson adjusts the lens.

Photo 3—The projection lens and 30-kv tube.



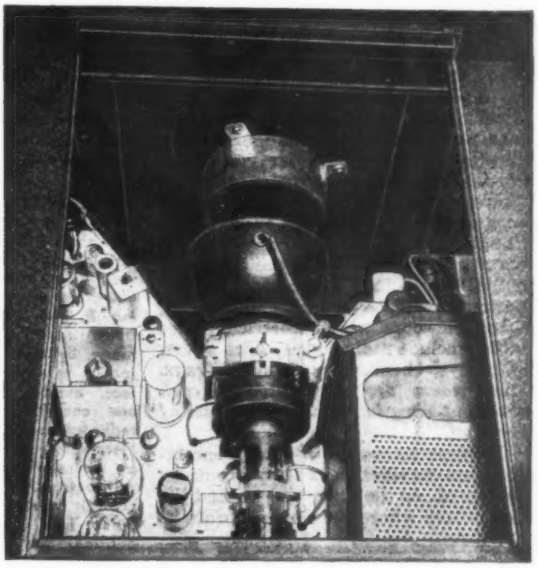
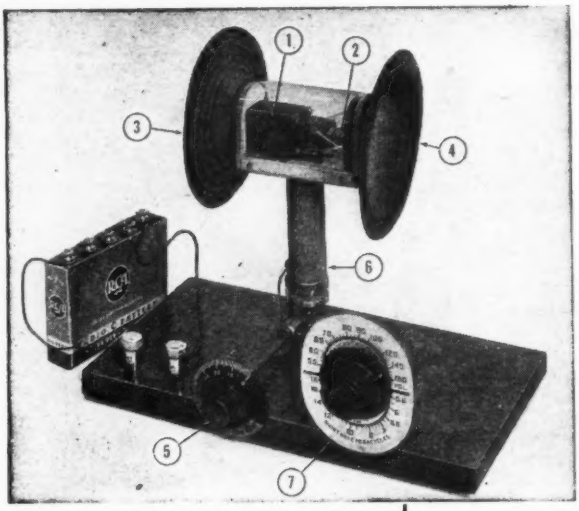


Photo 1, above—The 30-kv r.f. unit and the low-voltage power pack which supplies it. Fig. 2, right—Top view of a standard televiser showing how the high-voltage projection tube and lens are installed.



A recent model of the tubeless Homo-Heteradio which contains neither tubes nor radio parts, except a rheostat. 1. Special high-speed motor. 2. Supersonic siren. 3. Intake of radio waves. 4. Loudspeaker. 5. Dial to rotate Heteradio mounted on shaft 6. 7. Rheostat, which controls motor speed, tuning the radio.

Tubeless Homo-Heteradio

By MOHAMMED ULYSSES FIPS, I.R.E.I.R.E.*

A completely revolutionary type of radio is described here. It bears not even a remote resemblance to present-day radios. It is so new that readers will have to reorient their thinking completely from present-day radio technique.

EVER since the advent of the vacuum tube and our modern radio receiver, we have read from time to time that a tubeless radio had been invented.

Despite many press notices, up to very recently no radio which did not depend on the electron tube existed to the best of my knowledge. I exclude from this the typical old crystal receiver which worked beautifully with excellent reproduction. It, too had no tubes.

The question, therefore, arises: How could a tubeless, crystalless radio set come about? In my opinion—which goes back for many years—it should not be impossible to build a *purely mechanical* radio, completely disregarding our present radio ideas. Some time ago I set out to prove just that. The present article is the result of my exhaustive investigations and studies on this fascinating subject.

To begin with, speaking broadly, the waves which broadcast our present radio signals from our radio broadcast stations are no different than any other vibrations in space. I refer you to the schedule on the next page entitled: "Table of Vibrations," whose effects are recognized today. You will observe that the entire known spectrum of vibrations starts with the first octave and goes up to the 62nd octave at present. In this spectrum will be found sound-waves, supersonic sound waves, electrical waves (which include radio waves) heat waves, light rays, chemical rays, and X-rays. *These waves are all related to each other, but vary in frequency, or rate of vibration.*

The first octave, be it noted, encompasses waves vibrating at two vibrations per second. At the other end we find the 62nd octave where the waves vibrate at the enormous frequency of 4,611,686,618,427,389,904 vibrations per second.

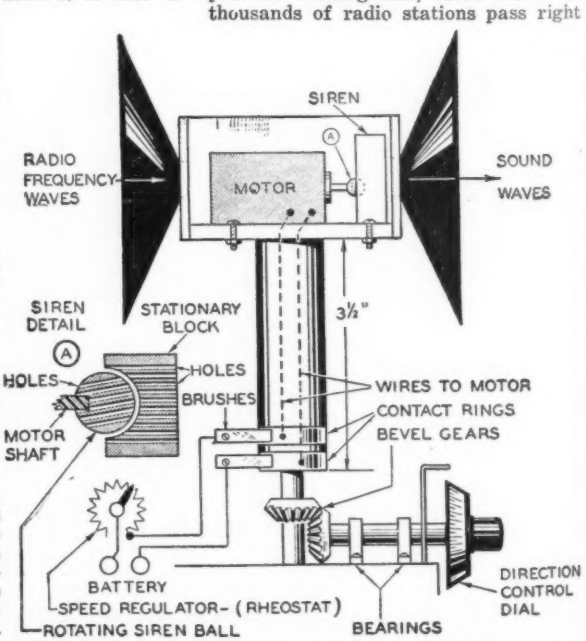
Electrical and radio waves, known as electromagnetic waves not only vibrate much faster than sound waves, but in an unknown manner. Sound waves are vibrations of physical substances, such as air, water, the metal of bells, etc. If we enclose an electric bell in a bell-jar and pump the air gradually out of it, the sound dies away. Radio waves move better when there is no air in their path than through it, or any other medium. We know that radio waves are of a vibratory nature but neither Drs. Alexanderson, Armstrong, and de Forest together can tell us *what* it is that vibrates.

Radio waves as we have seen, are related to sound waves *except that they vibrate infinitely faster.* The human ear cannot hear these radio waves for the simple reason that somewhere above 18,000 vibrations a second the human ear can no longer detect the waves directly.

Scientists think that there may be some living entities that can hear radio waves, but so far this has not been proved.

Thus we know that canary birds can hear supersonic waves around a frequency of 30,000. Presumably there may be insects or other organisms that can hear much higher up the scale, but this today remains merely an assumption.

We do know, however, that the radio waves are all around us. Indeed, while you are reading this, radio waves of thousands of radio stations pass right



Elements of the new heteradio. The heart of the new radio is the supersonic siren shown also in detail "A". The siren gives from 500,000 cycles upward taking in the entire broadcast frequency range. By means of a special heterodyne effect, audible sounds are converted from radio frequency waves. Heteradio motor runs by means of small 6-volt battery. Direction control moves Heteradio into optimum position to receive radio frequency waves.

*Islamic Royal Euclidean Intransigent Radio Engineers

through you, through your head, through your body, and through the building in which you sit (except where steel or other metallic masses cut off the waves.) Because the human ear cannot directly hear radio waves we must make them heard by means of crystal detectors, or radio tubes in various ways well known to every radioman.

Using radio tubes, we first detect the wave in our detector tube; then after detection we step it up by means of high amplification after which it is fed into the loudspeaker. The latter then gives off sound waves which we hear at the lower frequencies between 8 and 18,000 vibrations a second.

This method is a most circuitous one and it is easy to see that there should be something much less complicated than our complex radio sets.

At this point I must digress and show that in principle the tubeless radio is really not revolutionarily new, because in the past radio waves *have* been made audible to the human ear *without* radio crystals or radio tubes.

If you wish to read more about this I refer you to H. Gernsback's editorial "Superadio" printed in the April 1947 issue. In December 1946, Johns Hopkins University scientists accidentally discovered that a strip of Columbium nitride about the size of a pin, when cooled to minus 444.4 degrees Fahrenheit detects radio waves *without* any radio tubes. Radio programs could be heard distinctly, however, it was necessary to have the Columbium nitride strip connected to an amplifier.

Going back even further, as you will read in the same editorial—ever since radio broadcasting started in the early 20's, newspapers from all over the world have reported a number of most unusual and unorthodox radio reception cases. For example a cold-water faucet a block away from a Boston radio broadcast transmitter emitted music or speech when the water was turned on. A few blocks away a housewife almost fainted when a frying pan on a gas stove gave out music and lectures that could be heard throughout the flat.

But nothing much was ever done about these effects in reducing them to a workable radio receiver without using orthodox radio tubes and other radio components. Here matters rested.

Many of these instances were probably special cases of ordinary electrical detection. The celebrated case of John Moscowitz, the Newark cutlery worker, who at all times heard station WOR, is a case in point. Engineers discovered that carborundum particles from his grinding wheel had lodged in the metallic bridgework of his teeth, making him a living crystal receiver.

How the currents thus detected were turned into sound has never been satisfactorily explained, but it is supposed that part of his auditory nerve when stimulated by the modulated currents from his bridgework passed the sensation of sound to the brain.

No such explanation will serve in the case of the cold-water faucets, or frying pans, which picked up and reproduced broadcast signals. Here the radio waves acting directly on physical matter produced *sound*. It was these instances I studied, and from them I learned how sound was produced *directly* from radio waves—learned, indeed, to duplicate such effects.

The secret of the mystery lies in the statement a few paragraphs back "radio waves travel better when there is no air or other medium in their way." It has long been known that radio waves are *absorbed* in air, and to a much greater extent in better conductors. But absorption merely means that the radio wave *does work* in the medium—transfers some of its unknown *electrical* energy into mechanical energy—actual motion of the molecules of the substance through which it passes. This is of course the secret of the examples just given. Water or iron set in motion by the waves, usually assisted by some *rectifying* action which reduced the effect of radio frequency vibrations and allowed their audio modulation to stand out, is probably the explanation of all these effects.

I was soon able to produce speech and music with a variety of such devices. Only trouble was that, like the old crystal receiver, they were dependent on power received from the broadcast station. Loud signals were obtainable for only a mile or so from high-powered broadcasters. *What was needed was a source of local power*—like de Forest's B-battery—which could be modulated or controlled by the incoming signal.

I imagined a *purely mechanical* wave converter which would make radio waves audible. Here is the way I finally worked it out in building my revolutionary receiver.

Suppose we wish to detect and listen directly to radio waves having a frequency of 570,000 cycles (570 kc), which is equal to 526.3 meters.

For this we build a supersonic siren which can go beyond 570 kc. To drive the siren we use a powerful extra-high speed electric motor. We put an ordinary rheostat in series with the motor so we can control its speed *accurately*. We now connect the motor and the rheostat to the battery and drive the motor at the correct speed.

I found out that in order to do so the motor would have to run at the rate of 300,000 revolutions per minute, or 5,000 revolutions per second. That is pretty high speed and at present hard to obtain.

But, suppose we take the fifth harmonic or 100,000 cycles. The speed of the motor can, therefore, be made much lower, or 1,000 revolutions per second—60,000 revolutions per minute. This today is not impossible of obtaining.

Now we must have a siren. No standard siren could operate at this speed without flying to pieces. So I designed a Ball-Siren. This comprises a steel ball which has bored through it a number of small holes at an angle. Around this small ball, which is only about 3/16 inch in diameter, a shell was built exceedingly close to the siren ball. This made a tiny siren giving off high-frequency supersonic sound. As the weight of the ball rotor is less than 2 grams, at the high centrifugal speeds to which the ball is subject it will not undergo destructive strains. I found it was necessary to use an especially high-grade steel so it would not fly apart under the stresses at the tremendous speed.

Now, when the siren is turned on at full speed I can readily obtain sufficiently high supersonic vibrations at radio frequencies from 500,000 cycles upward, through the entire broadcast band.

How can we now *hear* the radio waves? This is done by simply creating interference between the siren waves and the radio waves. *In other words, a heterodyne effect.*

Incidentally, the heterodyne effect, first demonstrated by Fessenden, operates as follows:

A local generator of radio-frequency waves is made to generate signals a few hundreds or thousands of cycles away from the frequency of the incoming signal wave. The two sets of waves, being

(Continued on page 62)

TABLE OF VIBRATIONS

Whose Effects Are Recognized and Studied

	Number of Vibrations per Second	
1st Octave	2	
2nd "	4	
3rd "	8	
4th "	16	SOUND
5th "	32	
6th "	64	
7th "	128	
8th "	256	
9th "	512	
10th "	1,024	
15th "	32,768	SUPERSONIC
20th "	1,047,576	
25th "	33,554,432	RADIO
30th "	1,073,741,824	
35th "	34,359,738,368	LITTLE-KNOWN RADIO & INFRA-RED
40th "	1,099,511,627,776	
45th "	35,184,372,088,832	
46th "	70,368,744,177,644	HEAT
47th "	140,737,468,355,328	
48th "	281,474,976,710,656	
49th "	562,949,953,421,312	LIGHT
50th "	1,125,899,906,842,624	ULTRA-VIOLET
51st "	2,251,799,813,685,248	UNKNOWN
57th "	144,115,118,075,855,872	
58th "	288,230,376,151,711,744	X-RAYS
59th "	576,460,752,303,423,488	
60th "	1,152,921,504,606,846,976	
61st "	2,305,843,009,213,693,952	COSMIC & UNKNOWN
62nd "	4,611,686,618,427,389,904	

The above table gives vibrations from the 1st to the 62nd octave, to better understand the operation of the Tubeless Heteradio receiver.

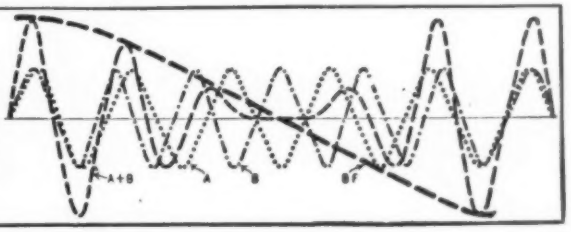
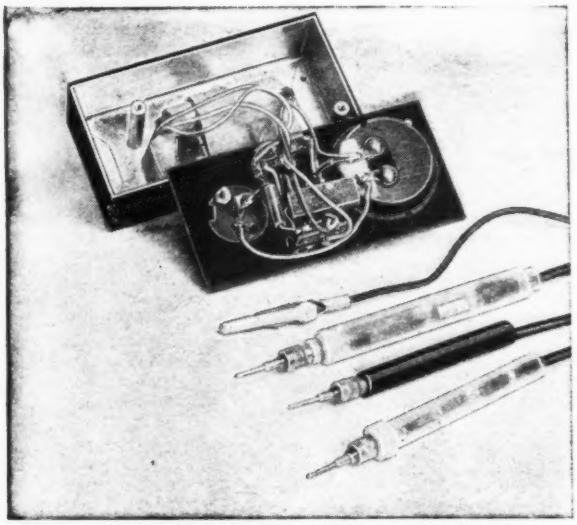
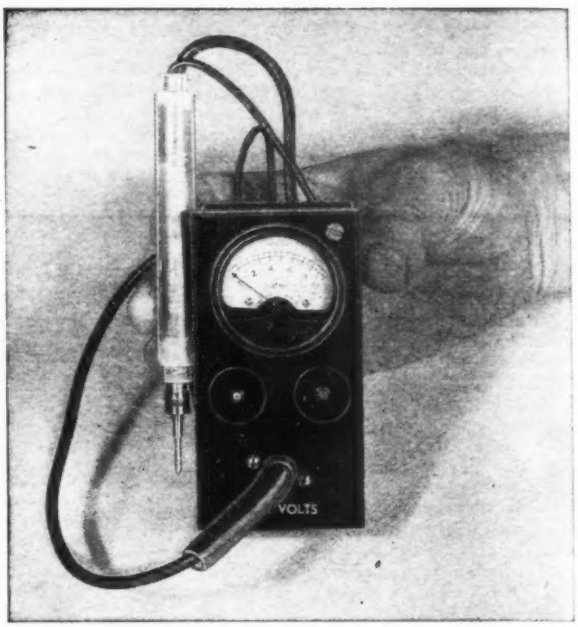


FIG. 1

Heterodyne action. If frequency A is (for example) 1,000 kc and B 1,001 kc, a wave of the form A + B will be produced. This produces a 1,000-cycle note (BF) in following circuits.



Tube is not seen, but is directly under the small carbon resistor.



Front view of the voltmeter and one of the polystyrene test prods.

TINY *Self-Powered Electronic Voltmeter*

By LOUIS L. KWASNIEWSKI

DURING recent years the vacuum-tube voltmeter has steadily gained in popularity, so that today hardly a service laboratory is without one of these useful and versatile instruments. Test equipment manufacturers were quick to recognize their superiority and there are several excellent instruments on the market today.

Most commercially built vacuum-tube voltmeters suffer from one drawback; they were designed for operation from a 115-volt, 60-cycle source. They are therefore completely useless for portable work or for measurements in areas where a.c. is not available.

To overcome this obstacle the vacuum-tube voltmeter shown in the accompanying pictures was designed and built. Very small in size (2 x 1¾ x 4 inches) and battery-operated, it has several features besides those usually found on line-operated instruments. It is completely free from stray r.f. pickup—a very desirable characteristic when working on high-frequency transmitters or oscillators. A high degree of accuracy was attained through careful electrical design, and the calibration remains essentially constant throughout normal battery life. Only standard, RMA-approved components are used, and, though some of the parts may appear unconventional, all are available either through a jobber or directly from the manufacturer. Despite its diminutive appearance, this little unit does a man-sized job and does it well.

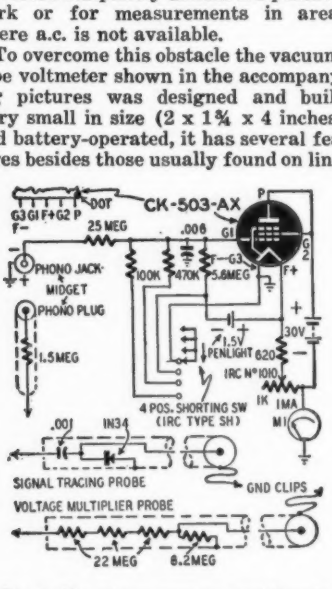


Fig. 1—The v.t.v.m. uses no special parts.

The electrical circuit (Fig. 1) is conventional in all respects except for the rather novel way in which the on-off switch is combined with the range selector. This was done to conserve space. The number of ranges is limited by the contacts available on the selector switch, but the 3 chosen ranges of 10, 100, and 500 volts are sufficient for most purposes.

The selector switch and the zero adjuster are of the newly developed miniature type, intended for use in hearing aids and miniature radio equipment. Their vital parts are all encased in the knob itself, and only the connecting pins protrude through the base. Because of their construction these controls must be mounted on a panel of bakelite or some other insulating material. When soldering to these controls take care not to overheat the connecting pins as the knobs are of phenolic material with a comparatively low melting point.

The tube is a Raytheon subminiature CK503AX, a power pentode type. Since there are no advantages from pentode connection in this service it is operated as a triode with the plate and screen tied together. This particular tube has leads about 2 inches long; these are soldered directly in place, dispensing with the conventional socket. A short piece of soft rubber tubing may be slipped over the glass envelope to provide further protection against mechanical shock. The meter is a small 1½-inch diameter unit, designed especially for use in miniature measuring instruments by the MB Manufacturing Co. Any small meter with a 1-ma movement can be used with equal results.

This vacuum-tube voltmeter may be assembled in any convenient case that the builder may have on hand. If none is available, a small plastic soap box or a cigarette container will do the job very nicely. All the parts are mounted on the panel, and the batteries are held in the box by a small metal clip.

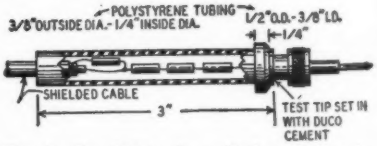


Fig. 2—The 5,000-volt multiplier and probe.

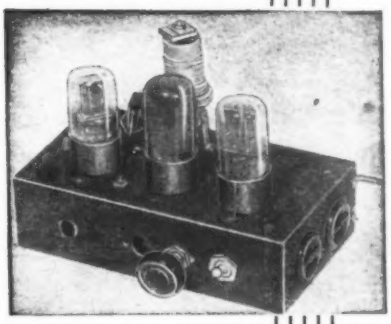
No special precautions beside those already mentioned need be observed and the remaining constructional details are self-evident from the pictures. Under some circumstances, especially if different parts or a different meter is used, the calibration may vary somewhat, necessitating a change in the value of the voltage divider resistors.

To increase further the utility of this

(Continued on page 64)

Capacity-Relay Intruder Alarm

By MILTON KALASHIAN



CAPACITY relays have literally hundreds of applications, but they are best known in intruder alarm circuits. These simple electronic circuits convert a change in condenser capacitance into an electrical impulse capable of operating a relay. They are often used on self-leveling elevator cars. Two condenser plates, across an oscillator tank circuit, are connected to the floor of the car. A thin strip of material—metal or dielectric—is mounted on each landing so that, as the strip passes between the condenser plates, the oscillator shifts frequency, operating a relay through a change in plate current. The relay stops the car when it is level with the landing.

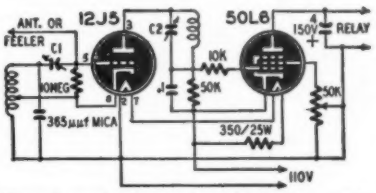
In other applications, one condenser plate may be mechanically coupled to a movable object that is to perform some task when it reaches a certain position. If, for example, the plate is connected to a float in a water tank, this circuit can control the flow of water or sound an alarm when the water reaches a predetermined level.

The basic capacity relay is a self-excited oscillator with a tuned coil and sensitive relay in its plate circuit. A *feeler* or antenna (a metal plate or length of wire) is connected to the grid. The grid circuit is tuned by a fixed or variable condenser shunted by the capacitance between antenna and ground. If anyone approaches the antenna, the capacitance across the coil increases and the oscillator frequency is lowered. In some cases, the capacitance change is sufficient to pull the circuit out of oscillation.

Some circuits operate with the grid and plate circuits at resonance so the plate current is not high enough to operate the relay. When the plate circuit is tuned to the oscillator frequency, plate current is at minimum and rises sharply when the tube stops oscillating or when either circuit is detuned. When anyone nears the antenna, the grid circuit is detuned and plate current rises. The abrupt plate-current change is used to trigger a control relay and open or close external circuits as desired.

The plate circuit is tuned a few kc lower than the oscillator in some circuits. The normal plate current is then high enough to keep the relay closed. A disturbance in the antenna field lowers the oscillator frequency toward that of the plate circuit. The increased excitation lowers the plate current, and the relay opens. Relay contacts are usually arranged so external circuits are closed as the relay drops out.

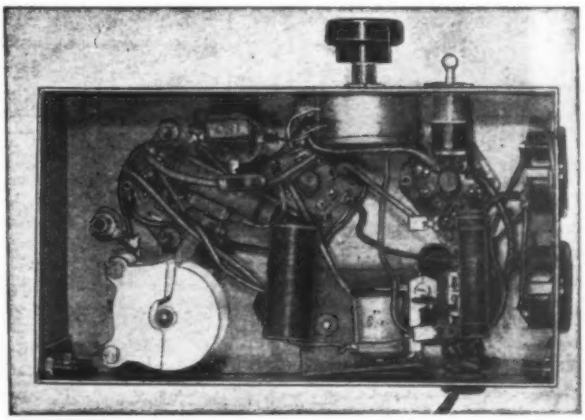
Such circuits are comparatively insensitive because of the wide plate-current swing required to open or close the relay. If the oscillator operates in the broadcast band or on a lower frequency, there must be a large change in antenna-to-ground capacitance to produce a useful change in plate current.



The schematic. R1 is the 50,000-ohm resistor in the 50L6 grid and 12J5 plate circuit.

More sensitive circuits

The sensitivity of the unit can be increased by operating on a much higher frequency. A change in antenna-to-ground capacitance can then shift the oscillator several megacycles and cause an appreciable change in plate current. A disadvantage is that increasing the frequency makes the oscillator susceptible to thermal, electrical, and mechanical changes, and to tube aging. Any of these may shift the frequency and sound a false alarm. If the oscillator is operating on shortwave bands, there is a chance that it will cause illegal interference to broadcast or communication services; particularly if a long antenna or feeler is used.



Under-chassis view. One tube, as noted, is in circuit merely to fill an empty socket.

Intruder alarm

This capacity relay, designed as an intruder alarm, operates along the general lines of those just discussed but has greater sensitivity due to a direct-coupled amplifier between the relay and oscillator plate circuit.

The oscillator is a 12J5 connected as a self-rectifying Hartley oscillator with a tuned plate circuit. The grid coil is a standard broadcast oscillator coil with cathode tap. Mica padders tune this coil to around 500 kc.

The plate circuit is tuned to the oscillator frequency by the secondary of a standard antenna coil. The primary is unused. The plate circuit is tuned with a 650-μμf (maximum capacity) padder condenser mounted on the coil form. A commercial coil was used in this position because it has a higher Q and tunes more sharply than a hand-wound coil. The high-Q plate coil produces a comparatively large change in plate current with slight detuning. The coils used were a Meissner 14-1033 and 14-1022, but equivalent coils would, of course, do as well.

The 50L6 direct-current amplifier is connected across a 50,000-ohm resistor, R1. The oscillator current causes a voltage drop across this resistor. The d.c. amplifier is so connected that this volt-

(Continued on page 68)

British Radio Design

European conditions produce some very interesting circuit features

By MAJOR RALPH W. HALLOWS*

THE path of the British broadcast radio designer is not easy. Except for a few who specialize in fine-quality receivers, all manufacturing firms regard the low-priced set as their main source of sales and profit. Our idea of low prices in radio are very different from those which prevail in America. For reasons into which I cannot enter into here, it is scarcely possible in Britain to produce a domestic receiver selling at a basic price of less than the equivalent of about $60, on top of which there is a 21.5% purchase tax, bringing the minimum price close to $73. Our tube manufacturers sell competitively at rock bottom prices to set manufacturers and look to the sales of replacement tubes at maintained prices through radio stores for the bulk of their profits. These maintained prices are high—several times greater than those paid by set manufacturers. One result is that the man in the street hesitates to invest in a receiver containing more than a small number of tubes, fearing the expense of replacements.

For this reason and certain others, such as the prevailing shortages of manpower, components, and raw materials, the designer of low and medium-priced radio sets is limited to the use of not more than 4 tubes, in addition to the rectifier. We don't as a rule include the rectifier, which after all need not be a tube, in the number of tubes stated in receiver specifications.

For the $70 to $100 which he pays for the small radio receiver, the British buyer expects these things:

1. Besides ranges from 5-20 mc and 500-1,500 kc, the tuning bands must cover 150-300 kc, for much important European broadcasting is done on the low frequencies;
2. Selectivity must be good enough to separate stations on channels 9 kc apart, for that is the basis of the present frequency allocation on this side of the Atlantic;
3. Arrangements for the use of a pickup must generally be provided;
4. The set must be adjustable to work on any line voltage between 200 and 250 volts.

The designer, then has at his disposal a maximum of 4 tubes with which to produce a set meeting all these requirements. Clearly, if he is to produce a best seller—or even a good seller—he must get the utmost possible performance from his quartet of tubes. At first sight it doesn't seem possible to ring many changes on 4 tubes. The set must be a superheterodyne. That seems to indicate a triode-heptode as mixer; a variable-mu pentode as i.f. amplifier; a duo-diode-triode as detector, supplier of a.v.c. voltage, and first a.f. amplifier; and a pentode as output tube. That is just about all that you can do with 4 tubes—or is it? Let's see. It would be an advantage if you could cut the tubes down to 3 and still produce a superheterodyne with the required performance. A 3-tube superhet, with ample output from its loudspeaker? We have several! The Mullard MAS 305, for example, is shown in Fig. 1.

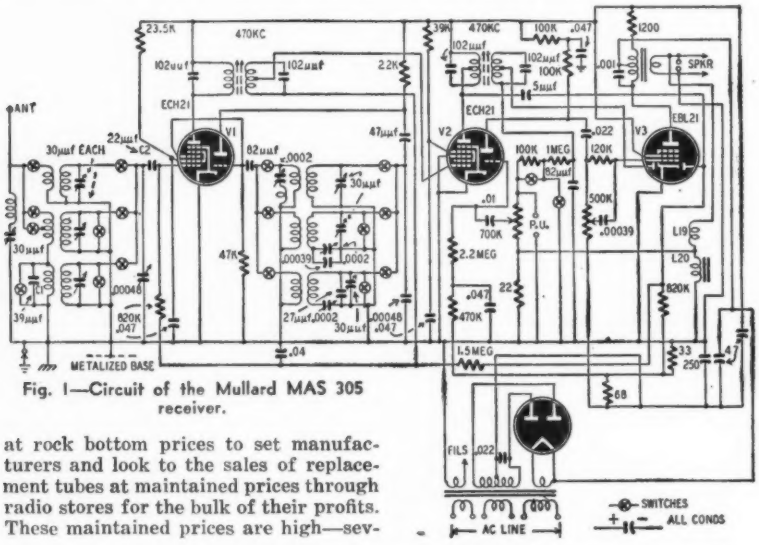


Fig. 1—Circuit of the Mullard MAS 305 receiver.

In this receiver we have the curious and ingenious combination of 2 variable-mu triode-heptodes and a duo-diode-pentode. The first triode-heptode V1 functions quite normally as a converter, with injector-grid coupling between the 2 sections of the tube. V2 is used in an

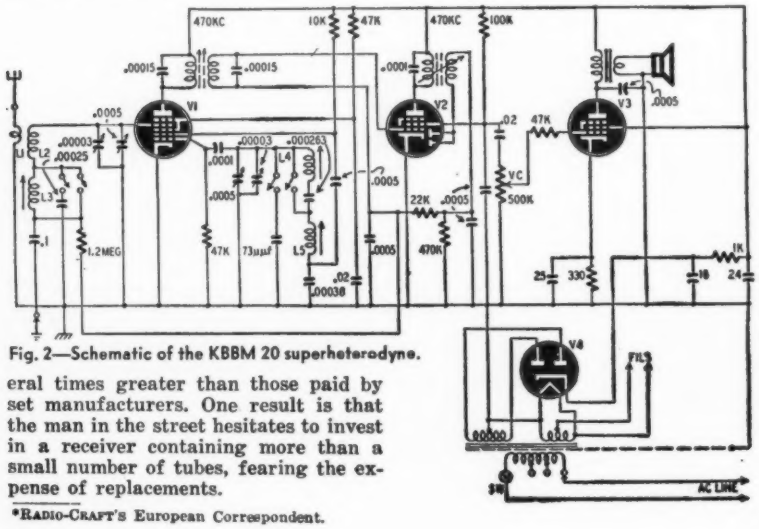


Fig. 2—Schematic of the KBBM 20 superheterodyne.

Typical British console is the Murphy A-104.

*Radio-Craft's European Correspondent.

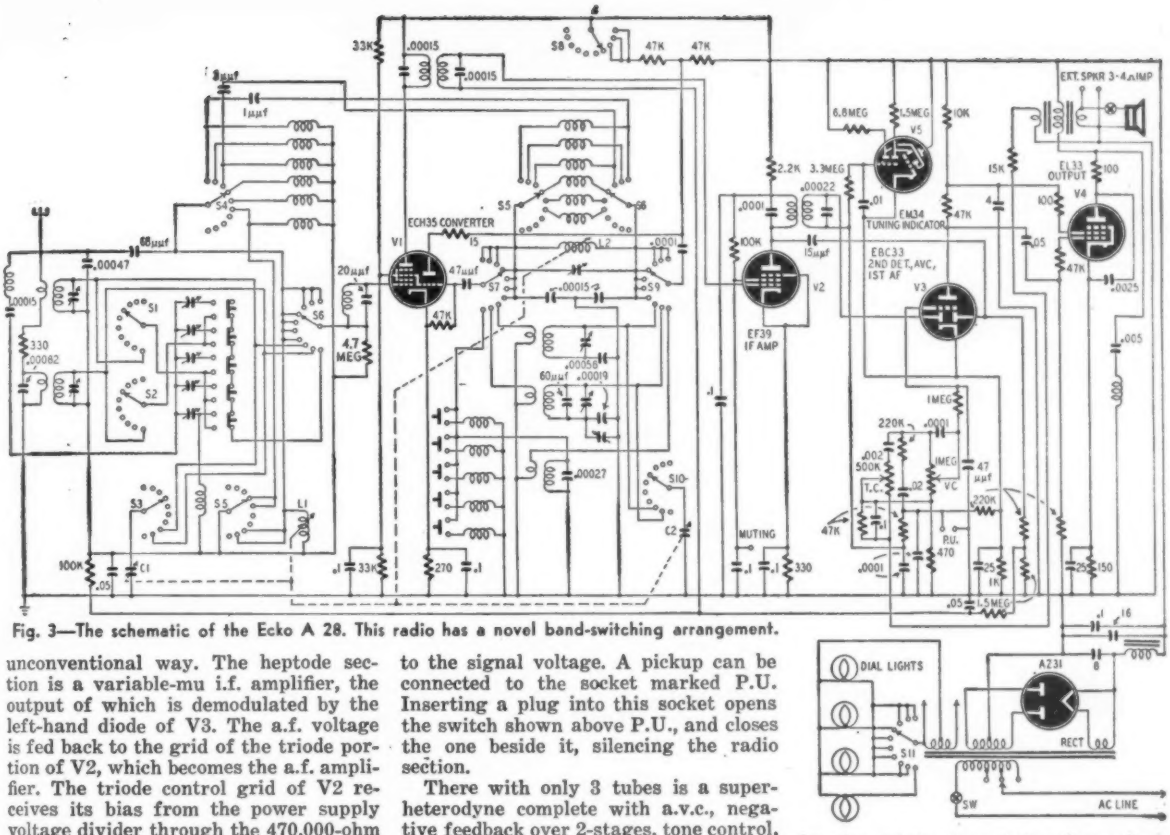


Fig. 3—The schematic of the Ecko A 28. This radio has a novel band-switching arrangement.

unconventional way. The heptode section is a variable-mu i.f. amplifier, the output of which is demodulated by the left-hand diode of V3. The a.f. voltage is fed back to the grid of the triode portion of V2, which becomes the a.f. amplifier. The triode control grid of V2 receives its bias from the power supply voltage divider through the 470,000-ohm decoupling resistor and the 2.2-megohm grid resistor. The a.f. from the detector is filtered by a 1-megohm resistor and an 82-μμf bypass condenser. A.v.c. voltage from the right-hand diode of V3 is developed across an 820,000-ohm resistor and is fed through a decoupling network to the heptode control grids of V1 and V2. The .0039-μf condenser and the 500,000-ohm potentiometer in the grid circuit of V3 form a continuously variable tone control.

Negative feedback is provided in a novel way. A.f. voltage from the secondary of the output transformer is taken to the frequency discriminating circuit L19, L20, and the 22-ohm resistor in series with the volume control. The voltage across this resistor is fed to the control grid of the triode V2 in antiphase to the signal voltage. A pickup can be connected to the socket marked P.U. Inserting a plug into this socket opens the switch shown above P.U., and closes the one beside it, silencing the radio section.

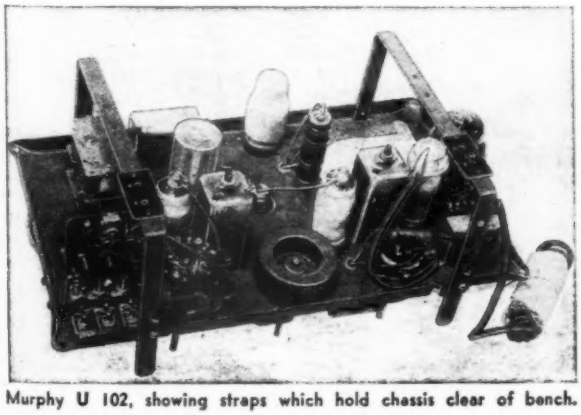
There with only 3 tubes is a superheterodyne complete with a.v.c., negative feedback over 2-stages, tone control, and provision for phonograph pickup. The trio of tubes is doing the work of at least 7 tubes. The set may be used either with its built-in plate antenna or with an outside aerial.

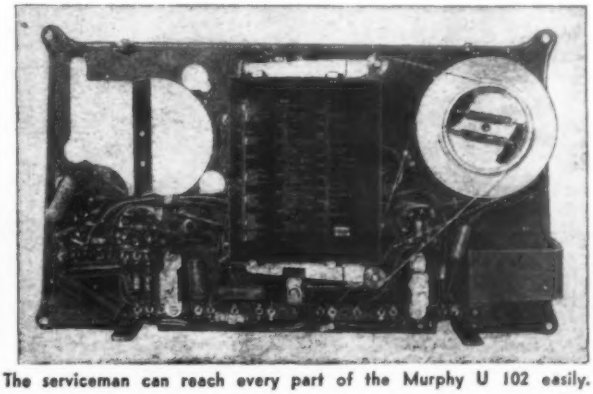
Another clever example of the 3-tube superheterodyne (the KBBM 20) is seen in Fig. 2. Here the tubes are a heptode, a variable-mu duo-diode-pentode, and a beam tetrode. The first tube is a straightforward electron-coupled converter. The pentode portion of V2 is reflexed and it acts first as an i.f. amplifier, transformer-coupled to the output of V1. The output of its pentode plate circuit is fed to the 2 diode plates. The a.f. voltage is developed across the 470,000-ohm resistor in the diode circuit, and fed through an R-C filter back to the control grid of V2, where it is amplified by the triode formed by the cathode, control grid, and screen grid. The .02-μf condenser in the screen-grid circuit couples the output to the control grid of V3, and the .0005-μf condenser bypasses any remaining r.f. to ground. The resistor in series with the control grid of V3 is an r.f. stopper. Another part of output of the diodes is fed back to the control grid of V1 as a.v.c.

The intermediate frequency of these sets is 470 kc.

Radio manufacturers are beginning to pay more attention to the needs of the man who has to repair their sets when they go bad. Not so long ago receivers seemed almost to have been designed with a view to making repairs and adjustments as difficult as possible!

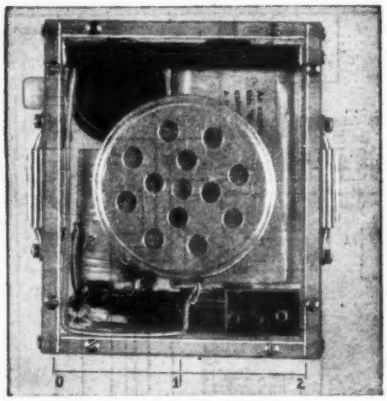
(Continued on page 82)





Murphy U 102, showing straps which hold chassis clear of bench. The serviceman can reach every part of the Murphy U 102 easily.

COVER FEATURE



Close up view of transmitter.

Brunetti Wrist-Watch Transmitter

By HUGO GERNSBACK

Even smaller radios than this 2-x 3-inch transmitter may be made when smaller and better batteries are built.

PERHAPS the most revolutionary advance in radio set building methods was developed during World War II. This is known as the printed circuit technique.* The man chiefly responsible for most of the new ideas in this branch of radio is Dr. Cledo Brunetti and his co-workers of the National Bureau of Standards.

When it became necessary, during World War II, to design extraordinarily small radio sets which, however, had to be extremely efficient at the same time, it was Dr. Brunetti who solved the host of problems which made these tiny radios possible.

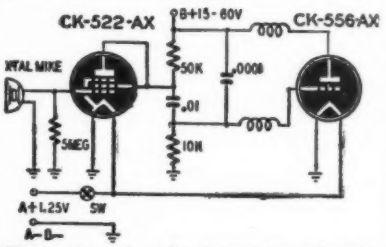
In the proximity fuse, for instance, a tiny radio transmitter with combined radar was required. This entire transmitter (complete with batteries, tubes, etc.) is so small that it fits in the head of the small projectile. In use the shell is set to explode at a predetermined height from the ground, or from any object it may pass in flight. When the shell reaches this point, a radar impulse bouncing back from the ground (or object) to the shell, activates the proximity fuse, which now bursts.

Actually millions of these were manufactured during World War II and did much in helping to win the war. Many similar radio weapons were designed by Dr. Brunetti and his associates.

Dr. Brunetti, who is the Chief of the Engineering Electronic Section of the National Bureau of Standards, is a physicist of the first order. He and his associates had to overcome tremendous difficulties in compressing a standard radio transmitter into a space that measures less than the fist of a small child. Extraordinary problems had to be solved in carrying out this work, which included much pioneering in many different directions.

*See RADIO-CRAFT, June and September, 1947 issues.

So important has this new technique become, that the Bureau of Standards felt it necessary to bring out a 44-page book entitled: "Printed Circuit Techniques" by Cledo Brunetti and Roger W. Curtis. This is a National Bureau of Standards circular No. 468, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., for 25c. In this book will be found all the various complex techniques that have enabled Dr. Brunetti and his staff to build radio transmitters actually down to the size of a lipstick case (minus batteries and microphone).



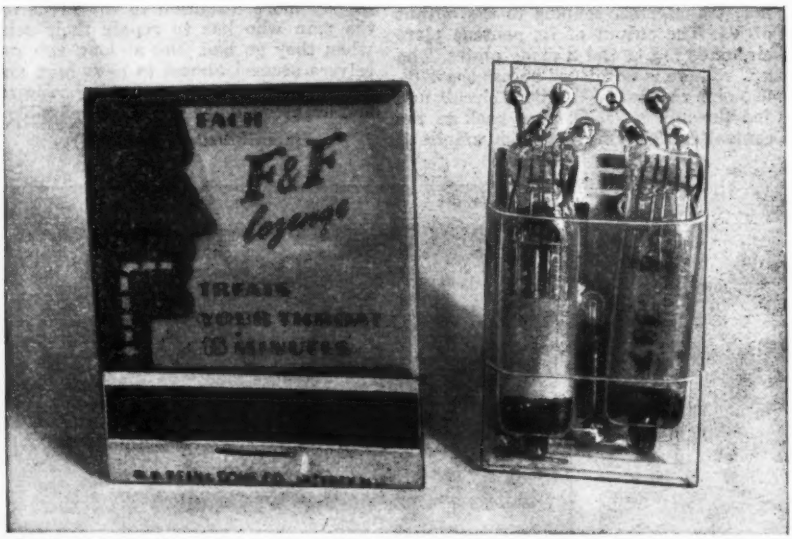
The wrist-watch radio transmitter schematic.

One of the most recent Brunetti developments is his wrist-watch radio transmitter featured on this month's cover. It is so small that it can be worn like a wrist watch. The entire transmitter (including crystal microphone, A and B batteries) is all housed in the plastic case. The size of the case is 2¼ x 2 11/16 inches. From the diagram it will be noted that there are two tubes, a CK522AX and a CK556AX.

These are well-known miniature battery types. The A-battery is a small Mallory dry cell which measures about 1 inch in diameter and ⅝ inch in height. The B-battery is a small hearing-aid type manufactured by several battery manufacturers.

The wrist-watch radio is a transmitter only and has no receiver. There is no aerial, yet the transmission is reliable over a range of about 100 ft. Any receiver tuned to the correct wavelength (in the 6-mc region) can receive the signals.

In a demonstration, which the writer witnessed, Dr. Brunetti was walking



Dr. Brunetti's smallest and latest transmitter compared with a box of ordinary book matches.

about the floor whispering into the wristwatch radio, yet his voice came out clear and strong from the table radio receiver at a considerable distance away from the transmitter. As a matter of fact it is necessary to be some little distance away, otherwise there will be an audio feedback howl.

Dr. Brunetti built a similar miniature pocket-radio for President Truman, which was presented to him on Christmas Day. In the White House there are a number of receivers attuned to the President's transmitter. The President can now walk about the entire White House, including grounds, and talk to the personnel wherever he is located. It is not possible to "talk back" to the President as there are no radio transmitters for the White House staff.

There are many practical uses for wristwatch transmitters of this type, only a few which are listed here:

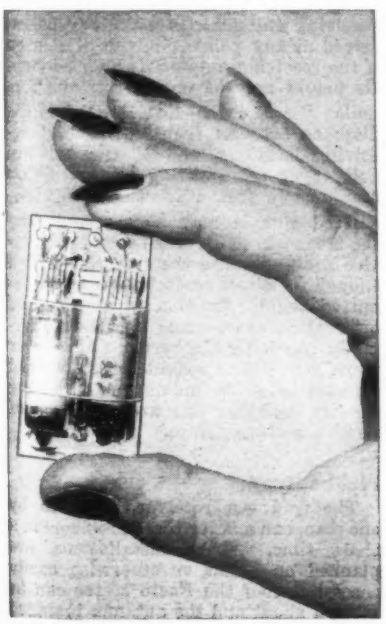
During building construction when the architect or the foreman wishes to talk to a temporary office, contact can easily be established.

Such a walking transmitter is a great boon in commercial departments between stock clerks and main office.

For mines, quarries, etc., foremen—if equipped with a wristwatch radio—can keep in touch with the distant office at all times. It would be particularly effective during mine disasters. These are only a few uses. There are of course thousands of others.

Dr. Brunetti has not stopped at the small wristwatch radio, but has since developed even smaller units. A number of these are reproduced here for the first time in any publication.

There is, for instance, an astonishing new two-stage audio amplifier, illustrated in these pages, which is incredibly small. This amplifier (complete with tubes) is a cylindrical plug-in unit and weighs 17 grams (a little over half an ounce). It is 1¾ inches long and 11/16 inch in diameter. The prongs are 7/16 inches long. The entire amplifier is cast in solid transparent plastic. Therefore, it cannot be taken apart or opened. The only way this could be done would be by dissolving the plastic in a solvent. It could not be taken apart mechanically because in the process all the parts would be ruined. The circuit diagram of this transmitter is also reproduced here. It is probably at the moment the smallest two-stage audio amplifier ever made.



Another view of the new smallest transmitter, shown also on preceding page.

Since Dr. Brunetti constructed his wristwatch radio—shown on the cover of RADIO-CRAFT this month—he has developed an even smaller one. It is the smallest ever built up to now. The small flat two-tube transmitter is shown in our illustrations. The entire circuit is printed on a 1/16 inch lucite plate; the transmitter (tubes, resistors, circuits, base plate, etc.) weighs exactly 8 grams (2/7 oz.). The tiny set, smaller than a book match, measures 1 inch by 1 15/16 inch and is 5/16 inch in maximum height.

As we go to press Dr. Brunetti has come up with some even more astonishing versions of his miniature radios. During the first part of last February he demonstrated his "Half-Dollar Radio Station" before the local section of the Institute of Radio Engineers in Washington.

He exhibited a whole "network" of radio broadcast transmitters which he carried in his pockets. Among others he demonstrated a tiny transmitter which fits in an empty lipstick container. He also had a "Calling Card Radio," the size of a calling card.

His "Half-Dollar Broadcasting Unit" is built on a square which barely covers a 50c piece. The thin plastic square measures 1¼ inches each way. Flat painted lines, which are the radio circuits, are used instead of wires. The tiny tubes are soldered to the flat surface. Small hearing-aid batteries supply the power for this sub-miniature radio station.

Dr. Brunetti also presented a duplicate vestpocket transmitter and receiver of the type presented to President Truman, as above mentioned.

These small radio transmitters and receivers are no longer in the theoretical stage nor are they "stunt" exhibition pieces. The National Bureau of Standards, in a recent survey revealed that more than 65 radio manufacturers have begun to use printed circuit techniques in various of their products.

There is already in use at present a hearing aid manufactured with the printed circuit. Plans are under way for two-way personal radios at present.

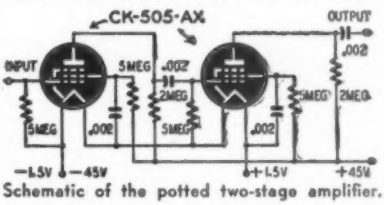
Dr. Brunetti illustrated to the assembled engineers at Washington how large stores can use the midget transmitters in routine inventory taking. The idea for this use of miniature radios came from an executive of a large chain store. One clerk would count the stock, broadcasting by radio the resulting stock figures to the main office where they would be recorded and tabulated. This would be quicker than having the clerk write down the results himself, because he could not count stock while writing, whereas the voice transmission to a competent stenographer works twice as fast.

This plug-in amplifier is hermetically cast in a Bureau of Standards-developed potting (plastics) resin.

At the present time Dr. Brunetti and his staff feel that while the electronic parts of their radios have shrunk to a size never contemplated before, the battery interests have not kept pace with electronic developments.

Both A and B batteries still bulk many times the space of electronic parts of the miniature radios. It is along this line of attack that greatest progress is expected in the immediate future.

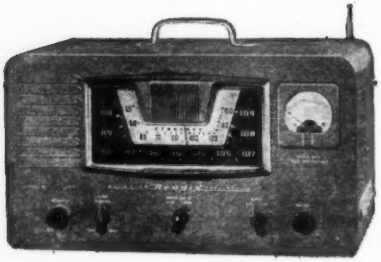
During the war years dry-battery manufacturers have made some advance in reducing dry cells to smaller size, but they are still far too bulky and much too large.



Schematic of the potted two-stage amplifier.

If it were not for the bulky batteries, Dr. Brunetti's various transmitters and receivers could be made far smaller than they are today. It is felt, however, that this problem too will be solved in the near future, once the battery interests understand how tremendously important sub-miniature radios will become in the future.

Radio Set and Service Review



Bendix Model 847S "Facto Meter"

THE new Bendix Model 847S field test receiver—called the Facto Meter—is an 8-tube, a.c.-operated, FM-AM portable set. It is designed specifically as an aid to radio installation crews and servicemen making field-strength measurements on FM and standard AM broadcast bands.

Its tuning range is 540—1620 kc and 88—108 mc.

The set is enclosed in a metal cabinet 11 inches high, 17¾ inches wide, and 6¼ inches deep and features a large built-in tuning meter and a 33¼-inch telescopic antenna that may be used on FM and AM reception. This antenna can be connected to either the FM or AM antenna terminals by a switch on the side of the cabinet. A 300-ohm FM antenna and a single-wire broadcast antenna and ground can be connected to terminal strips on the rear of the chassis.

The tuning meter has two sensitivity ranges. The ratio between ranges is 5 to 1 on the AM band and 10 to 1 on the FM band. It has a linear scale calibrated 0 to 10. When the meter reads 5 or above on the high range, excellent FM reception is possible at the location where measurements are made. When the needle falls between 1 and 5, reception is good. On the low range, readings between 1 and 5 show poor reception, and above 5 shows good reception. The set should be tuned for maximum needle deflection on each station.

FM *vs.* AM propagation

There is considerable difference in the propagation characteristics of standard broadcast frequencies and the very high frequencies used for FM. The broadcast signal—1600 kc or lower—has a tendency to follow the earth's surface and may be received on the ground wave for distances of 400 miles or more under normal terrain and atmospheric conditions. Obtaining fair broadcast reception is no problem — even in remote locations—as the average broadcast set will pull in a number of stations if given a chance.

In steel-framed buildings, the structure may absorb the signal and cause dead spots and poor reception on sets with built-in aerials. Outdoor aerials improve reception, but there are times when they are not practical or their use is prohibited. In such cases the Facto Meter can be used to locate spots accurately where signal levels are highest, and sets will give best results within the building. Areas of maximum signal strength are located by extending the antenna of the field test receiver and moving it around the room or building while watching the meter. Meter deflection indicates spots where the signal is strongest.

FM signals—in the order of 100 mc—act very much like light rays and travel in straight lines with comparatively little bending. Best reception is usually obtained when the receiving location is in the service area—where receiving and transmitting antennas are in the *line of sight*. This distance may be calculated from the formula: $D1=1.4\sqrt{H}$. D1 is distance in miles, H is elevation of observation point in feet, and 1.4 is a constant use to allow for v.h.f. refraction. Fig. 1 is a comparison of broadcast and v.h.f. signals.

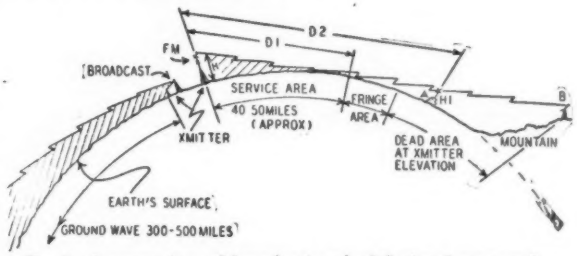


Fig. 1—A comparison of broadcast and v.h.f. signal propagation.

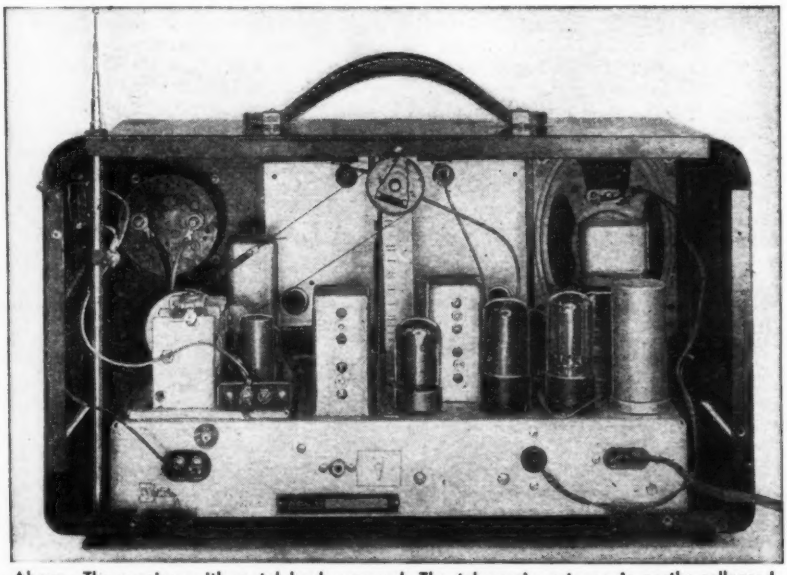
The service area of an FM station depends largely on the height of its antenna above surrounding terrain. The service area includes all the space within a radius of D1. H is the height of the transmitting antenna. Reception is possible in the fringe area where the receiving antenna is normally below the line of sight but signals are relatively weak. Best results are obtained when the receiving antenna is mounted as high as possible so as to extend the line-of-sight path between transmitting and receiving antennas. Signals may be received at any point A in the dead area if the receiving antenna is high enough. Its height may be found from the formula: $D.2=1.4\sqrt{H}+1.4\sqrt{H1}$. D.2 is the distance between transmitting and receiving locations, and H and H1 are heights of transmitting and receiving antennas in feet, respectively.

Good signals may be received atop the mountain at B—far beyond the service area—because the receiver is high enough for direct reception of the transmitted signal. (Antenna installation and orientation can become a problem normally requiring the services of two or more men.) The height, location, and orientation of the antenna and routing the transmission line are problems of particular importance.

Field survey

The field test receiver, operated by one man, can answer these problems in a short time. Where installations are planned on a flat or otherwise easily accessible roof the Facto Meter can be carried about and the antenna installed

(Continued on page 76)



Above—The receiver with metal back removed. The telescopic antenna is partly collapsed.

The Junior Demon 5-Watt Transmitter

By G. CARROLL UTERMAHLEN, W3HVD

"JUNIOR" was a prewar baby, born of my desire for a compact transmitter capable of local and dx contacts with a minimum of power. This midget demon has, at one time or another, gone all out in his efforts to mate with another c.w. station and, at such times, has disregarded his usual operating procedures. Junior, you see, is trying for WAS!

Most hams have been spoiled by high power, so here is the chance to test *your* operating ability with the barest essentials! Junior is capable of getting out in a big way. A good antenna, proper tuning, and clean operating ability will enable this peanut whistle to reach hundreds of miles out into the night.

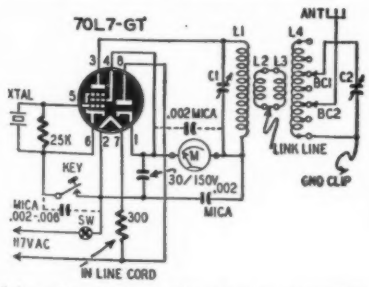
A 70L7-GT tube was used because it was the only tube of its type available when the original Junior was built. A 117L7-GT tube may be substituted for the 70L7-GT by omitting the line-cord resistor and noting the proper changes in tube socket connections. The circuit component values are not critical, but substitutions should be made with care.

Several of these little rigs have been built by other hams, and while some did make changes in parts values, all of the rigs worked very satisfactorily.

Construction details will vary with the materials available. The following dimensions are given as a guide for those who are interested in duplicating the original unit.

The aluminum chassis is of 1/16-inch stock, and is 2⅝ inches high, 6 inches long, and 3¼ inches deep.

A 3/16-inch slab of Masonite is used as a front panel. It is 5½ inches high and 6 3/16 inches long. All voltage-carrying parts are mounted on the front panel (under the chassis) or, if chassis mounting is more convenient, the parts should be carefully insulated from the chassis itself. *No ground should be allowed to come in contact with the chassis or any voltage-carrying component!*



Schematic of the 1-tube a.c.-d.c. transmitter. Two additional capacitors are suggested.

The crystal, tube, both coils, and the antenna-tuner variable condenser are above deck. The remaining parts are below deck. A careful survey of the chassis and panel will indicate the proper placement of parts with the least possible crowding.

Nearly every amateur agrees that the 40-meter band is the best for all-around good results with low power. Forty meters offers interstate QSO's with low power during normal periods, and still greater distances may be spanned during periods of skip. The 5-watter is designed to operate on 40 meters. It has been used with good results on other bands (80 and 160), but the coil data are for 40-meter inductances only.

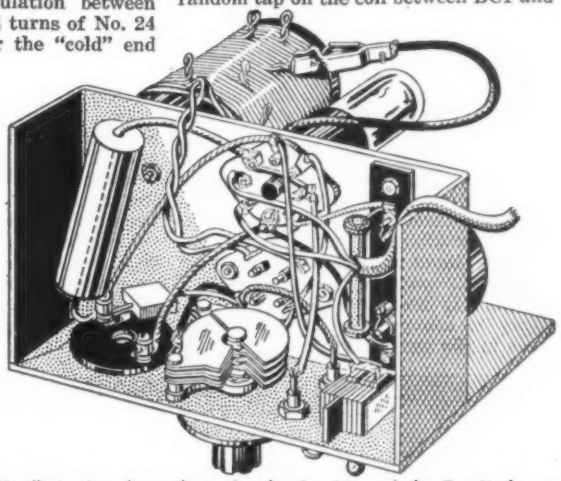
L1, the plate-tank coil, consists of 14 turns of No. 24 d.c.c. wire, wound on a standard 4-prong tube base 1⅝ inches in diameter. L2, the link-line coupling coil, is wound over L1 (using a thickness of paper tape as insulation between coils) and consists of 4 turns of No. 24 d.c.c. wire wound near the "cold" end of tank coil L1.

L3 and L4 are the antenna tuning coil. L4 consists of 38 turns of No. 14 enameled wire, close-wound, on a large size 4-prong coil 1½ inches in diameter, and is tapped at the 8th turn starting from the ground end of the coil. After the first tap the coil is tapped at every 5th turn. The placement of taps is *not* critical, but the more taps available, the better the coupler can be adjusted to a given load. Coat L4 with Duco cement and allow to dry before adding L3. L3 consists of 2 turns of hookup wire wound over the first 8 turns of L4. L3 is first wound over L4, after which the remaining wire is twisted to form the link-line, the opposite end of which is connected to L2. Before winding L3-L4, remove the 4 metal prongs from the coil form by sawing them flush with the bottom of the form with a hacksaw. Drill a hole in the center of the bottom to mount it on the chassis. BC1 and BC2 are small battery clips, and are shifted about on L4 when the transmitter is being matched to a given antenna.

Putting Junior on the air is a very simple matter and requires little effort. Plug the line cord into a convenient outlet, either a.c. or d.c., and the coil L1-L2 and a 40-meter crystal into their sockets. Set C2 at minimum capacitance, and with BC1 and BC2 *out* of the circuit, close the key and rotate the tank tuning condenser C1 until a flashlight bulb attached to a small loop of wire and held over L1 glows brightest. Then back off C1 a bit, so that the oscillator is not at the peak of resonance. If this is not done, either the oscillator will quit when the antenna is coupled to the transmitter, or the emitted signal will be rough or chirpy. *Remember: Do not operate the oscillator too near resonance!*

Antenna tuning

With the key *open*, attach BC1 about midway up the coil L4 and BC2 to a random tap on the coil between BC1 and ground. Connect a small 110-volt, 7½-watt bulb between BC2 and the antenna itself, close the key, and rotate C2 for maximum brilliancy from the bulb. If the bulb fails to glow, try different tap settings for BC1 and BC2. When the antenna tuning process has been completed, remove the bulb from the circuit.

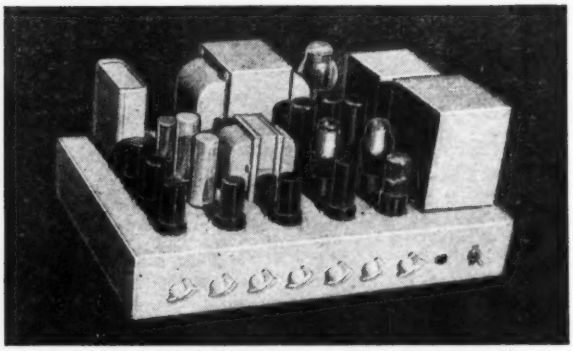


This illustration shows the under-chassis wiring of the 5-watt demon.

Tip jacks are provided for a 0-100 milliammeter. When not in use, they should be shorted with a piece of wire. Fully loaded and ready to go, Junior

(Continued on page 82)

Hi-Fi 35-Watt Amplifier



Front of the 35-watt high fidelity public address amplifier.

The author describes a good amplifier and tells how he obtained the design figures

By H. R. E. JOHNSTON

THE primary consideration in the design of a PA amplifier for the reproduction of music is frequency response. It is easier to extend the frequency range of an amplifier than it is to eliminate the hum and distortion that an extended frequency range usually reveals. As power is increased the problem becomes increasingly difficult.

Tentative specifications of our proposed new amplifier were:

1. Frequency response flat ±¼db from 50 to 15,000 cycles;
2. Distortion less than 1%;
3. Hum level 62 db down from full output;
4. 18-db negative feedback;
5. Bass boost and attenuation;
6. Treble boost and attenuation.

To be sure of obtaining results approaching these specifications, a great deal of theoretical work was done before construction was started. The design considerations as well as the finished product may be interesting to readers.

For low-power applications, low-mu triodes operating class A give good results and offer no problems in design. As power increases, class-A operation becomes prohibitively inefficient. To keep the power input within reason for power (20 to 40 watts output), class-AB1 operation is necessary. It is also necessary to use pentode or beam-power tubes in the output stage.

The second-harmonic distortion generated in class-AB1 operation is easily eliminated by connecting the tubes in push-pull. Distortion due to imperfect voltage regulation is a different matter and is more difficult to eliminate.

The usual procedure for reducing distortion when beam-power tubes are used, is to apply 10% negative to feedback from the plates to the grids. When 10% negative feedback applied to 6L6's, distortion is reduced by slightly more than half, or 6 db. The tube manuals rate 6L6's operating class AB1 at 2% distortion. Theoretically then, 10% negative feedback should reduce this distortion to less than 1%

However, the figure of 2% distortion is valid only when the tubes are working into a pure resistive load and with perfect regulation of all voltages. But under actual operating conditions, distortion is usually much more than 2%.

In the amplifier illustrated, this problem of distortion was attacked from both ends. First, by increasing the negative feedback factor and, second, by improving the voltage regulation. Ten percent negative feedback over one stage was not considered adequate. It was decided that the feedback factor must be increased either by increasing the gain A in the feedback loop or the percentage of output voltage B fed back. The most practical method was to increase A by applying negative feedback over 2 stages instead of one. The factor A then becomes A1A2 where A1 is the gain of the driver stage and A2 the gain of the output stage.

The gain of the driver stage is 9. The coupling network (explained later) introduces a loss of 1/3 or a gain of 2/3, and the output stage has a gain of 13. The total value of A in AB is 9x2/3x13 or 78. The negative feedback factor is 10% or —0.1, and is obtained from a separate winding on the output transformer. AB is then $78 \times (-0.1) = -7.8$.

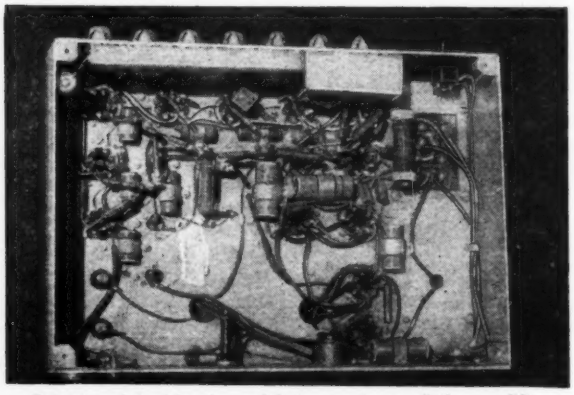
Hum and distortion reduction

1-AB is a factor by which the percentage of distortion without feedback is divided to determine the amount of distortion *with* feedback, and in this case is 1—(—7.8) or 8.8. Assuming that distortion within the tube is 3% and distortion due to reactance in the load is 5%, the total distortion without feedback is 8%. With negative feedback it would then be

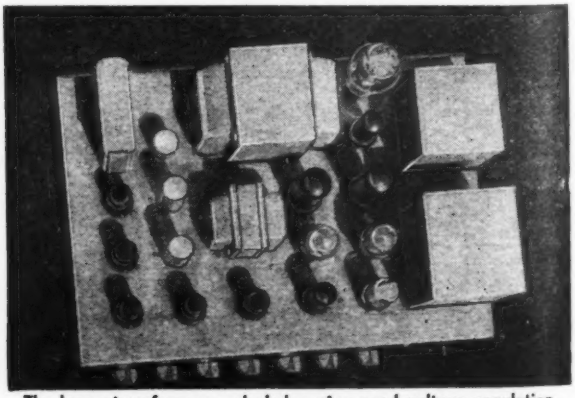
$$\frac{8}{8.8} = 0.91\%.$$

Any hum in the output stage due to inadequate filtering is reduced in the same proportion:

$$\frac{\text{hum without feedback}}{\text{1-AB}} = \text{hum with feedback.}$$



Point-to-point wiring is used between stages of the amplifier.



The heavy transformers and chokes give good voltage regulation.

As a point of interest, the hum level in this amplifier is 38 db down from the standard reference level of .006 watt.

Negative feedback also lowers the effective output impedance of an amplifier as shown in the equation:

$$\text{Effective output impedance} = \frac{Rp}{1-\mu AB}$$

where:

Rp is plate resistance of output tube;

μ is amplification factor of the output tube;

A is the gain between grid of driver and grid of output tube without feedback;

B is the voltage feedback factor.

The lowered effective output impedance greatly assists in damping out transients in the voice coil.

When a large amount of negative feedback is applied over 2 or more stages, oscillation at very low and very high frequencies often results due to phase shift. The coupling network between the driver and output stage was designed to prevent this from occurring.

Another factor to be considered is that change in gain with negative feedback determines the peak voltage required at the grids of the driver tubes for full power output.

The change in gain with negative feedback is given by the equation:

$$\frac{\text{gain without feedback}}{1-AB} = \text{gain with feedback.}$$

Since the over-all gain of the driver and output stages without feedback is 78 and 1-AB is 8.8, the total gain with feedback is 8.86.

The peak grid-to-grid voltage required by the driver is equal to the peak output voltage divided by 8.86.

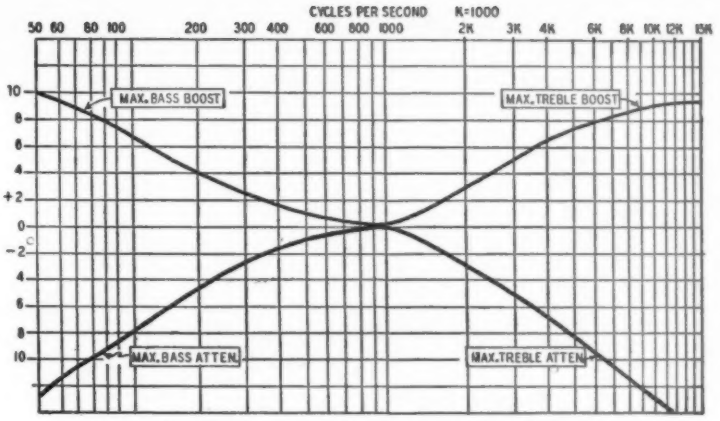

CYCLES PER SECOND
K=1000
50 60 80 100 200 300 400 600 800 1000 2K 3K 4K 6K 8K 10K 12K 15K
10 8 6 4 +2 0 -2 4 6 8 10
MAX. BASS BOOST
MAX. TREBLE BOOST
MAX. BASS ATTEN.
MAX. TREBLE ATTEN.

Fig. 1—Amplifier response under maximum tone control settings.

The r.m.s. plate voltage of *each* 6L6 at full output is the square root of ½ power output times ½ plate-to-plate load impedance, or:

17.5 × 3,300 = 240 volts r.m.s. The peak-to-peak output voltage is 240 × 1.414 × 2 or 679 volts. The voltage required by the driver is 76.5 volts peak.

The amplifier circuit

The front end of the amplifier is conventional. There are 4 inputs; 2 high-impedance microphone inputs, 1 phono input, and 1 radio input. There is a gain control for each input and a master gain control. The treble boost and attenuation circuit is located between the third and fourth stages. All single-ended stages are isolated from one another and the filtering in the decoupling network reduces hum to a very low level.

The frequency response is flat within ¼ db from 50 to 15,000 cycles. Distortion is less than 1%, and the hum level is 62 db down from full output. Total negative feedback is 18 db.

The power transformer has 2 high-voltage windings. One winding supplies plate and screen voltages for the output tubes; the other furnishes the plate voltage for the voltage amplifiers. Good voltage regulation is obtained by using a single-section choke-input filter, with a low-resistance choke and a transformer with good regulation. Good screen voltage regulation is provided by using 2 regulator tubes in series across the screen lead. Note well the size of the components in the illustrations. Plenty of iron and copper are necessary for the best audio quality.

Choice of an output transformer is important, but is limited to those having

(Continued on page 75)

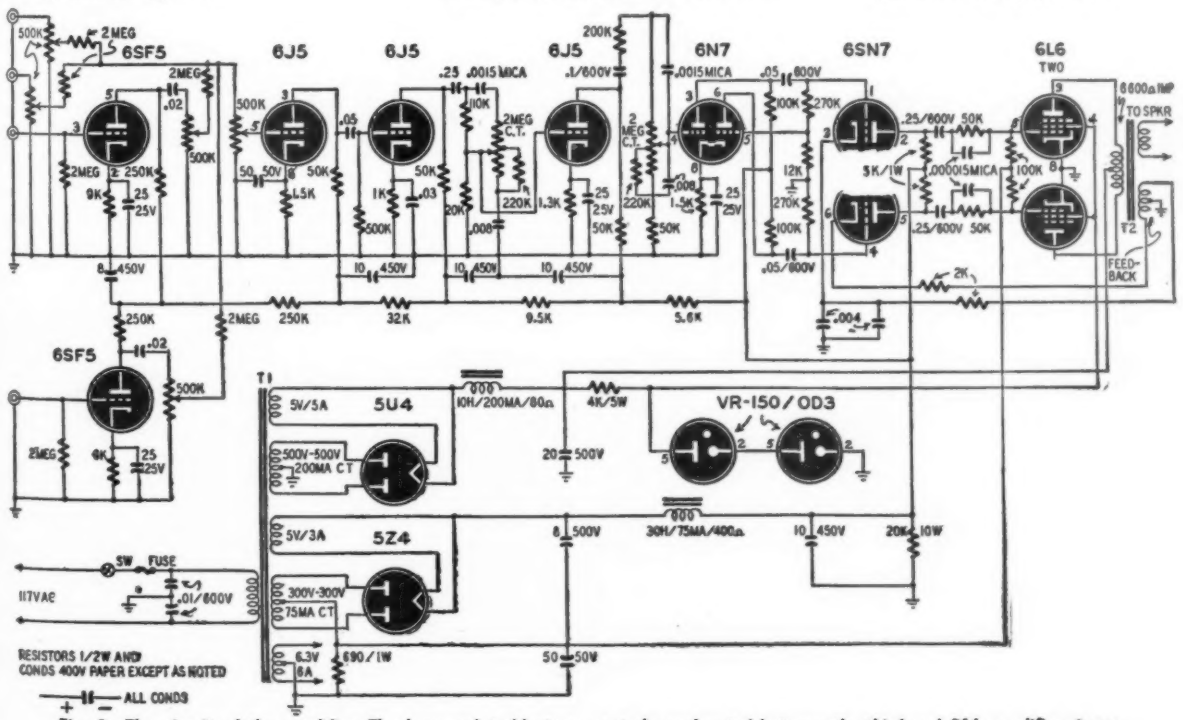
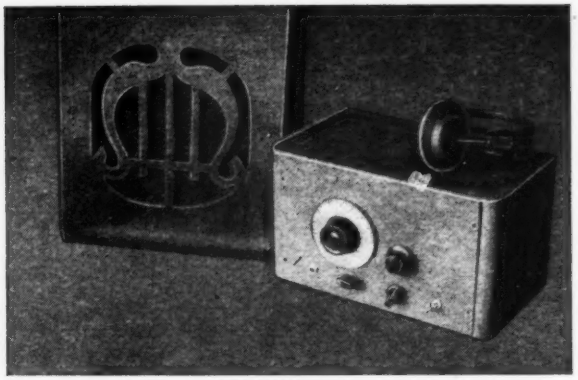
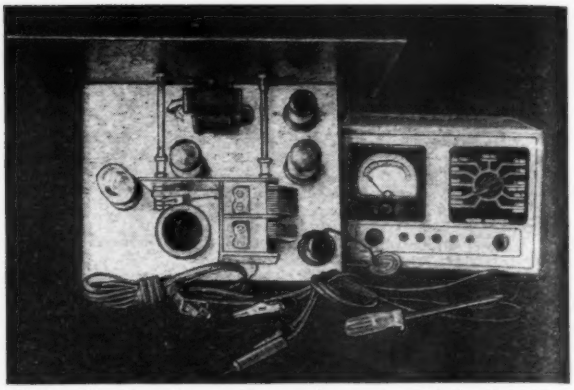


Fig. 2—The circuit of the amplifier. The bass and treble tone controls are located between the third and fifth amplifier stages.



The output transformer permits use of phones or magnetic speaker.



This top view shows how condenser placement avoids hand capacity.

A Stable Regenerative Receiver

By OTTO L. WOOLEY

MORE than 20 years ago we built our first receiver, a 1-tube regenerator. That 1-tuber, a WD-11, cost exactly $5. Small wonder then that for economic reasons the most popular set of that era was the one using the minimum number of tubes! For some reason, that trend of thought has continued through the years; but today when the same amount of money will purchase a double handful of far better tubes, any set builder is passing up a good bet if he doesn't use enough tubes to insure consistent maximum performance.

Looking through the tube manual recently we had a sudden urge to see what could be done with our old regenerative circuit. The straight regenerator has certain drawbacks. It is likely to radiate and it is sensitive to hand capacity. These disadvantages were reduced to the point where they were no longer objectionable by careful design and layout. Radiation from the receiver was eliminated by including an untuned r.f. amplifier.

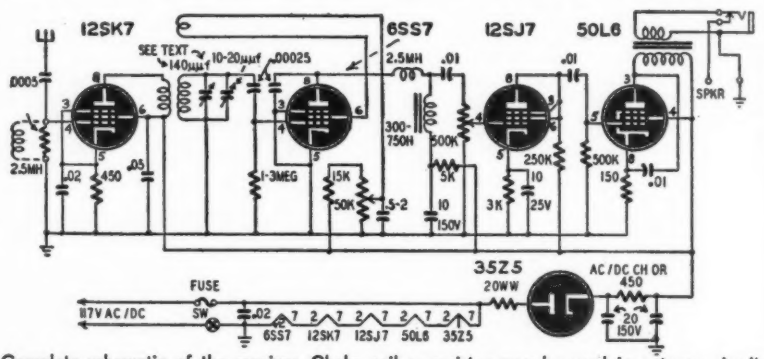
There is no noticeable gain in a stage of this type, but it stabilizes the detector, making the control of feedback non-critical. Furthermore, antenna effects due to antenna coupling to the detector are almost completely wiped out.

Hand capacitance has been a real aspirin-sales booster since the earliest days of radio. To combat this nuisance, a substantial steel panel was used. It was well bonded to the chassis with a short, heavy piece of copper braid. The parts were laid out so that the tuning unit and associated components remained well back on the rear portion of the chassis, and the band-set and band-spread condensers are coupled to the knobs by fiber shafts. The result is that no hand-capacitance effect is noticed, even on the 10-meter band.

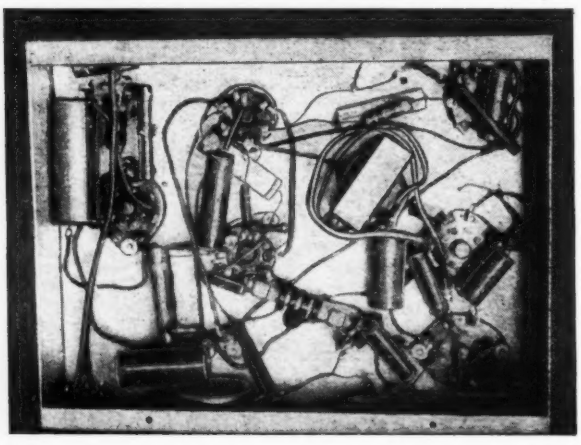
There is nothing new in any part of the circuit except possibly the use of a remote cutoff tube for the detector in place of the more commonly used sharp cutoff type. However, the 3 low-voltage tubes all have the same pin connections and can be interchanged to compare their operation.

The 20,000-ohm resistor in the grid circuit of the untuned r.f. amplifier may be replaced by a 2.5-mh r.f. choke.

A broadcast-type tuning condenser was used in this set. One designed for short-wave tuning might be preferred by SWL's. Standard, 3-winding, manufactured plug-in coils are used for the different bands. If these are unavailable they can be wound easily on standard coil forms.



Complete schematic of the receiver. Choke coil or resistor may be used in antenna circuit.



Under-chassis wiring is not critical except for the filament leads.

Impedance coupling is used between the detector and the first audio tube. A small audio choke of at least 300 henries is used. This type of coupling permits the detector to work into a more suitable load than if resistance coupling were used between stages.

The audio system is conventional except that the first audio tube is triode-connected. The output transformer has a 2,500-ohm primary to match the 50L6

(Continued on page 83)

A coil for the broadcast band can be constructed with a primary of 25 turns No. 30 or 32, a secondary of 90 turns No. 28, and a tickler of 15 to 20 turns No. 30 or 32. The coil is wound on a 1½-inch diameter, 6-prong coil form. Coils for other bands can be determined by experiment.

Tone Control Adventure

Engineer James Langham proves again that curves don't always mean results

By JAMES R. LANGHAM

IT was some time ago that the XYL came home with a story about a friend's big, fancy, custom-built radio. "Instead of just one knob that cuts out the highs, they have *two*. One boosts the lows, and one boosts the highs. Couldn't you rig us up something like that?"

"Why, I guess we can manage," I remarked foolishly. "You see, we make up an M-derived or constant K-filter section for highs and another for lows and . . ."

"I'm no engineer," she said. "You figure it out, and I'll build it."

I was young and innocent then: I *believed* what the textbooks said about filters, and I thought I knew a lot about electronics. So I got out the books and slide rule and spent about 2 hours computing the constants for a pair of bridged-T filters. I figured the sizes for 4 coils and 4 condensers and even plotted the theoretical curves for each. I drew up a sketch so she'd know just where to put them into the circuit and then tossed the papers lightly in her direction and departed. I don't know if I thought she'd have built it by the time I got home that afternoon or not. I may have. So help me, I may have.

The XYL was a mite irritated when I got home. "Look, knucklehead," she said, "you may be a fire-ball of a designer, but you sure aren't very practical."

"Mmmm?" I inquired. Mild curiosity. "Something troubling you, dear?"

She had a lot of catalogs and a worried look. "Where were you planning on getting these fancy chokes? Such as 0.183 henrys and 13.2 millihenries and —they're not standard sizes at all. Nobody sells them."

I grinned at her. "That's right, dear. You'll have to wind them up yourself or get someone else to do it."

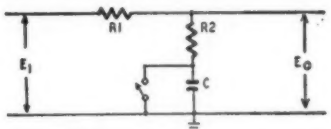
My tone was a mistake. She announced immediately (and loudly) that by all that was holy she was not going to wind up any coils. If I could persuade someone else to do it, O.K. If not, I would have to wind them myself.

Well, after I phoned downtown to a couple of places, I announced I would be glad to wind them. "I don't see how they can expect $15.00 for winding a simple little coil. I'll do it myself."

For the next month I wound coils. Air core and iron core. I used an egg-beater hand drill and bought quantities of wire. Then I would go over to the technical school and check them on the bridge. Then I would add or take off turns until the inductance was right. Then I would check the Q, and then get another form and start over again. Finally I had the 4 coils. They were within 2% of the design values, and they were nicely potted (beeswax and rosin). And I decided I had learned something valuable—it isn't easy to wind coils.

The XYL kept her word and wired the things up. She bridged condensers and found room on the chassis and did her wiring neatly with squared corners. She was really excited about it.

She put on Scheherazade—lots of highs and lots of lows. She wanted to twist the two new knobs and hear the ends go up and down.



$$E_o = E_i \frac{R_2}{R_1 + R_2}$$ WITH SWITCH SHORTED

$$E_o = E_i \frac{\sqrt{R_2^2 + X_c^2}}{\sqrt{(R_1+R_2)^2 + X_c^2}}$$ WITH SWITCH OPEN

Fig. 1—A circuit to boost the bass notes.

Something was a little wrong. The low control made the hum level go up and down, but it didn't seem to affect the low notes in the music. The high control was better. You could hear an increase in the high level when the control was twisted, but there seemed to be an unpleasant accompanying distortion there too.

We stood there glaring at each other. "The wiring *looks* nice anyhow," I got in the first blow.

"The engineering looked good too," she said sweetly. "Those curves were lovely. The theoretical ones, I mean."

I called for peace. "I guess that bass filter needs more shielding. It picks up hum."

She nodded. "I'll say it does."

We tried shielding the coils. (Incidentally, the best shielding seemed to be beer cans.) Then we tried putting a higher level into the filters so the induced hum would be lower than the signal. We even lit the low-level filaments with d.c. so the hum would be low enough.

After we did enough things it got almost fair. There were limits to the amount of boost we could give it, though. If we turned up the bass much, it sounded muffled; and if we turned up the treble to match, the distortion came up with it. One day I came home to find the XYL showing off our outfit to a friend. She pointed to a newly blank panel. "No tone control at all," she said. "We find that if the tonal balance is proper, tone controls aren't needed. In fact, we avoid distortion by not having any tone controls."

I listened and it sounded good. She had jumped over the filters and, by golly, it sounded better than it had for some time. So I adopted her line of reasoning and argued with the fellows that really high-fidelity amplifiers shouldn't have any tone control.

I was squelched soon by this argument: "What if your pick-up or your speaker or the record falls off at the

(Continued on page 70)

I figured the sizes for 4 coils and 4 condensers and even plotted the curves for each.

Most-Needed Circuits

Most-often-requested items are power supplies, converters, r. f. heaters and diathermy equipment

OUR technical staff receives repeated requests for diagrams of oscilloscopes, receivers, converters, electronic controls, and power supplies. A few of those most in demand are presented here.

Power supply for BC-654-A

The BC-654-A, a part of the SCR-284-A, is a receiver and transmitter tunable from 3700 to 5800 kc. The receiver and transmitter are designed to operate with power units PE-104-A and PE-103-A, respectively. These operate from 6- or 12-volt vehicular storage batteries and supply the receiver and transmitter with plate, bias, and filament voltages.

The PE-103-A is available on the surplus market and delivers 500 volts at 160 ma while drawing 21 amperes at 6 volts d.c. or 11 amperes at 12 volts d.c. These units are equipped with circuit breakers and are ideal for marine, mobile, and emergency transmitters or amplifiers.

The a.c.-operated supply shown in Fig. 1 is designed to replace the battery-operated units. The codes on the output terminals refer to connectors and their respective pin numbers on the BC-654-A. *Connections to pins 3 and 8 on connector 1K3 are reversed on sets with serial numbers below 9,500, and power-supply connections should be made accordingly.*

Full-wave dry rectifiers are used in the low-voltage sections of the supply. Rec 1 and Rec 2 are Mallory types 1B12C3 and 1BR4, respectively. Other makes may be used if manufacturers' specifications are followed closely.

The voltage across terminals 3 and 4 should not exceed 10.8 volts with no load. If the output from the rectifier with full load exceeds 6 volts, remove turns from Sec. 1. Maximum permissible a.c. voltage across terminals 1 and 2 is 3.6, and the output of the rectifier should not exceed 1.5 volts under load. Remove turns from Sec. 2 until voltage is normal.

These secondary windings supplying the dry rectifiers can be replaced with filament transformers altered to deliver the required output voltage. For example: Sec. 2 may be replaced with a 6.3-volt, 2-ampere center-tapped filament transformer. The halves of the secondary are connected in parallel.

Choke Ch 1 must carry at least 3 amperes. Its resistance should not be greater than 0.6 ohm. Ch 2 has a maximum resistance of 1.3 ohms and should carry 800 ma safely. Both chokes may be made by winding new coils on cores of old 200-ma chokes. Use No. 16 s.c.e. magnet wire on Ch 1 and No. 22 s.c.e. on Ch 2. Wind on as many turns as space permits and adjust the air gap for best filtering. The .013-henry, 4-ampere chokes currently available on the surplus market may be used for Ch 1 and Ch 2.

All-band converter

A number of surplus receivers tune to 455 kc. Some tune from about 600 kc down as low as 15 kc. Others cover portions of the long- and short-wave bands. The converter shown in Fig. 2 is designed to extend the range of the RAK-7, BC-453, RBL-3, and similar receivers through the broadcast band to 18 mc.

Oscillator and antenna coils are standard commercial 3-band assemblies designed to tune from about 540 kc to 18 mc when used with 365-μμf condensers and 455- or 456-kc i.f. amplifiers. Oscillator padders Cp are selected for use with the average assemblies tuning 540- to 1700-kc, 1700- to 5500-kc and 5.5- to 18-mc ranges. The capacitance of the padder increases with frequency range.

Other bands can be covered by selecting separate coils for the desired ranges. Follow manufacturer's specifications on oscillator padders. One set of broadcast coils and a set of 12- to 36-mc coils can be used to extend the range of the BC-348, BC-779, and similar receivers to include the broadcast and 10-meter bands.

The converter-output transformer T1 is a standard 455- or 456-kc i.f. transformer with the secondary coil and trimmer removed. The output of the converter is capacitance-coupled to the receiver antenna posts through a .006-μμf mica condenser.

Low-voltage D.C. supplies

Low-voltage d.c. supplies are handy for operating electroplating equipment, pipe and electronic organs, generator fields, testing automobile radios, and numerous other applications.

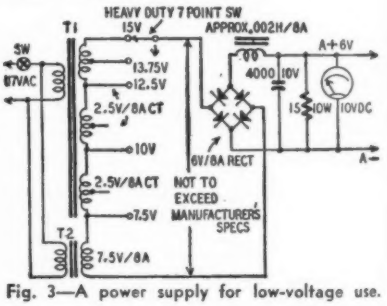


Fig. 3—A power supply for low-voltage use.

The circuit shown in Fig. 3 is designed to deliver 6 to 8 volts at up to 10 amperes, depending on the rectifier unit used. Operating conditions for dry rec-

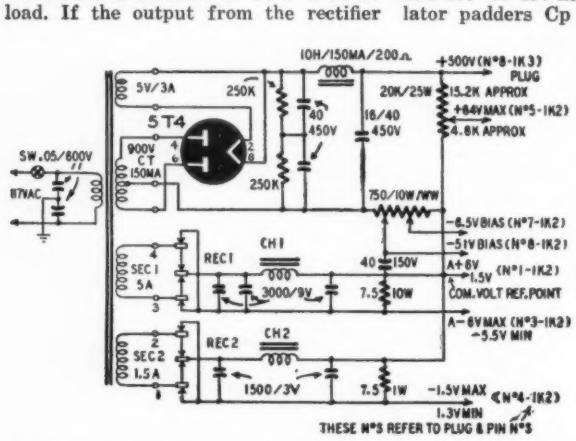


Fig. 1—Line-operated power pack for BC-654-A or similar receivers.

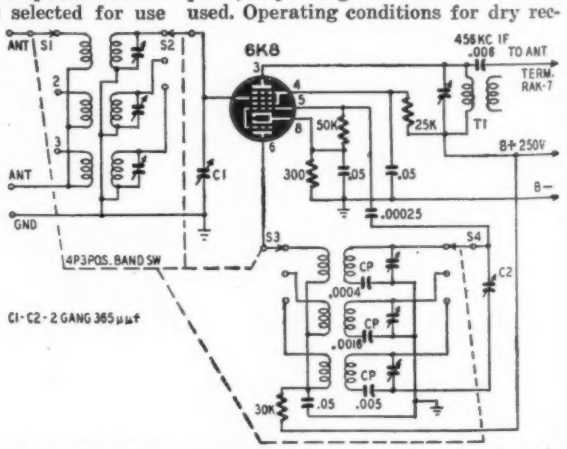


Fig. 2—This all-wave converter has an output frequency of 456 kc.

tifiers are comparatively critical, and manufacturer's specifications should be followed closely to avoid overloading or applying excessive input voltage when the unit is operating without a load.

Not too much data is available on the various types of commercial dry rectifiers although they are now in great demand for use in high-current supplies. The unit shown is a Mallory 1S16B7. Equivalents will work equally well. Just be sure that the rectifier selected is capable of delivering the required current. Do not permit the a.c. no-load voltage input to exceed manufacturer's specifications. Maximum no-load voltage for the 1S16B7 is 14.4 a.c. Do not use the 15-volt tap on the transformer unless line voltage is lower than normal.

T1 is a filament transformer with three 2.5-volt center-tapped, 8-ampere windings. T2 is a 7.5-volt, 8-ampere transformer. A heavy-duty 7-point switch is used to control the input voltage. This combination permits use of standard parts, though a specially wound transformer would be more convenient.

The filter choke is made by replacing the winding of a 200-ma choke with 100 turns of No. 14 enamel wire or No. 12 wire if space permits. Reassemble the choke and adjust the air gap for best operation.

Induction heater

Judging from the number of requests received, r.f. heating has become very popular with experimenters. A 1-kw dielectric heater was described in the February, 1948, issue of RADIO-CRAFT.

Fig. 4 is the circuit of a 1-kw induction heater. A unit of this type can be constructed from tubes and parts readily available on the surplus market. If a 304TH is unavailable at surplus prices, you may use a 304TL by changing the fixed portion of the grid leak to 4,000 ohms and adjusting the 1,500-ohm control for best operation.

Power input is adjusted with a Variac or similar control. A time-delay relay in the power line prevents application of plate voltage until rectifier and oscillator tubes have reached operating temperature.

L1 is 30 turns of 3/16-inch copper tubing wound with an inside diameter of 7 5/16 inches and spaced to occupy 12 inches. L2 is a 1-turn winding around L1. It is 13 inches long and has an inside diameter of 8¼ inches. It is formed in a cylindrical shape from 1/32-inch sheet copper. A ½-inch gap lengthwise through the coil prevents shorting. The coils are constructed as shown in Fig. 5. Heavy leads to L3 are connected to both sides of the gap. The size and shape of the work coil L3 depends on the application. Experiment with the size of tubing and number of turns to obtain best results.

Crystal-Controlled Diathermy

The FCC ruled recently that users of diathermy and r.f. heating equipment must either reduce radiation from their apparatus to a negligible degree by shielding or *operate within narrow specified bands.* In most cases, adequate shielding is impractical—making operation on the *diathermy bands* the only alternative.

The crystal-controlled diathermy circuit shown in Fig. 5 operates on 27.32 mc. It was designed and constructed by members of the Application Engineering Department of Eitel-McCullough, Inc., and described in the October, 1946, issue of *Electronics.*

The circuit uses a 6AG7 oscillator doubling in its plate circuit from a 6.83-mc crystal, followed by a 6L6 doubler driving the 4-250A final amplifier on 27.32-mc. Coils are wound as follows:

L1—12 turns No. 16 on 1-inch form, spaced to 1½ inches.
L2—10 turns No. 16 on 1-inch form, spaced to 1¼ inches.
L3—5 turns ¼-inch tubing on 2½-inch form, spaced to 4 inches.
L4—1 turn No. 8 around ground end of L3.
L5 and L6—6 turns No. 8 on 1-inch form, spaced to 2 inches.
L7 and L8—4 turns No. 8 on 1-inch form, spaced to 1½ inches.
L9—1 turn No. 8 mounted between output jacks.

Applicator pads for diathermy machines can be obtained from most electro-medical supply dealers.

Editor's note

(We have enough material on hand to run another article of this type covering receivers, transmitters and oscilloscopes if readers desire it.

There seems to be considerable interest in electronic controls such as photoelectric and capacity relays and timing, pulsing and counting circuits. Two or more of these circuits can be combined to produce some novel and interesting results. We may have just the circuit you are looking for. Let's hear from you.)

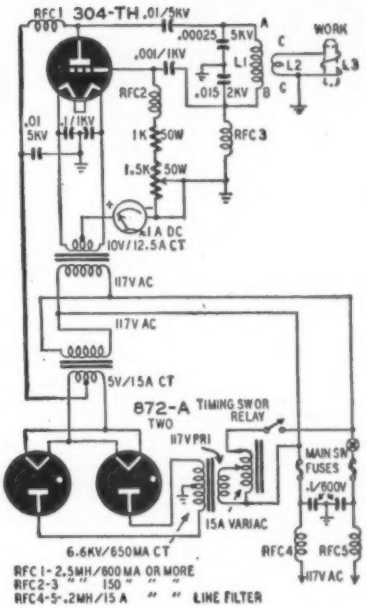


Fig. 4—A 1-kw r.f. induction heater.

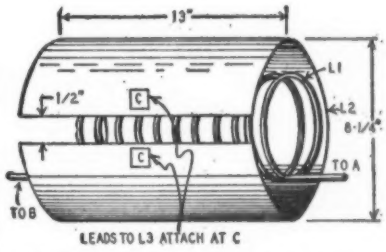


Fig. 5—The output coil is sheet copper.

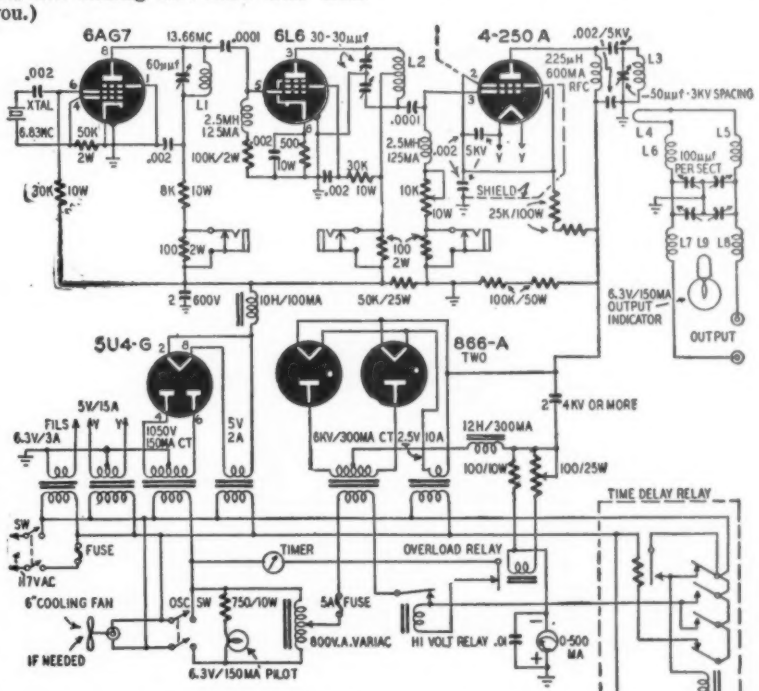


Fig. 6—This diathermy machine is designed to meet FCC requirements.

Transatlantic News

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

WHAT a marvelous instrument the modern television camera is! A few evenings ago I watched on the television screen a play which was transmitted from a theater in London in the course of an ordinary performance and without a single lumen of extra lightning. One or two afternoons later I saw an international Rugby football match played on a typically English winter afternoon when low clouds, mist, and fine drizzling rain combine to produce what the poets call a "dim religious light." (Football fans have other words for it.) Not much use switching on, I thought, after a glance through the window at the gloom outside. To my utter amazement the images were clear, sharp, and full of detail, although the commentators sitting in the grandstand complained bitterly about the difficulty of seeing what was going on. We televiewers, obviously, saw better than they did!

It will be a strange business if commentators change over to the screen of a television monitor tube on days when the light is too dim for the human eye to see the game direct.

The camera now used by the BBC is more light-sensitive than the eye. It incorporates a modified form of Zworykin's orthicon. I wonder if users of television receivers in this and other countries fully realize the magnitude of their debt to that great American genius? But for the iconoscope, supericonoscope, and image orthicon tubes, television might still be in the scanning-disc stage, with little or no entertainment value.

Table model televisers

I was interested to read in a recent number of RADIO-CRAFT that in America table-model televisers are expected this year to outsell consoles by about 2 to 1. The console is still the more popular model here, mainly because of the better quality of the sound reproduction, but it would not surprise me if people here soon begin to show a preference for the table model.

The height of the television screen above the floor is more important than many designers yet realize. It should not be much above or below that of the televiewers' eyes. The height depends, not only on the natural upholstery of the viewer and the artificial upholstery of his chair, but also on whether he prefers to take his television while sitting bolt upright, or lolling back at his ease. Screen-height in the console is fixed. But with the table model the viewer can sit as he pleases and arrange the height of the televiser to suit his own requirements. If, for example, the set normally rests on a rather low table, it can always be raised with some of those large, unread books which so many people's bookshelves contain.

There's another reason why the table model is winning popularity on this side of the Atlantic. Try asking half a dozen friends to see a television program on a console model with a 48-square-inch image. You'll not find it too easy to seat

This unusual table lamp conceals a 3-tube radio as well as a built-in loudspeaker.

them so that all can see reasonably well. It's fine for those in the front whose eyes are at about the right level, but the fellows standing behind them may not be very enthusiastic over the distorted images that they see. With a table model and a little ingenuity you can give everyone a good view. Here's a chance for inventors. Why not a table-type televiser standing on spring-loaded lazy-tongs supports? Raise or lower it to the height you want and it stays put!

The slot antenna

Quite a bit of attention is being given to the possibilities of the slot antenna for v.h.f. reception, including television Briefly, if in a sheet of metal you punch, hacksaw, file, or otherwise worry out a narrow slot of the correct dimensions and connect a feeder line to it as shown in the drawing, it behaves as a half-wave dipole, except that the polar diagram is the exact opposite of what you'd expect. The vertical slot has the same polar diagram as a horizontal half-wave dipole, and vice versa. In theory the plate in which the slot is made should be of infinite area, but very good working results are obtained with plates of reasonable size. The slot antenna was first used during the war, for centimeter radar. It's a ticklish job to erect and feed an array of half-wave dipoles for a wave length of, say, 5 centimeters. But the difficulty vanishes if you punch out the array as a pattern of slots in the walls of a wave guide, and the results are first rate. It is possible that arrays of slots made in the steel framework of apartment buildings can be used as master antennas to provide FM and television reception for every home in the building.

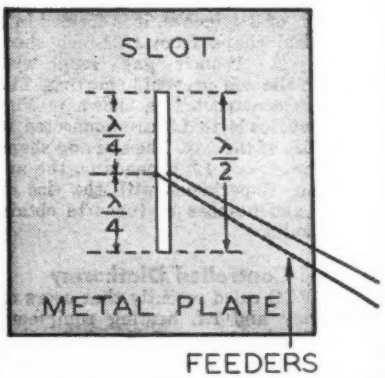
Map making by radar

There are enormous areas of the world surface which have never been accurately surveyed and mapped. Today their survey is being speeded by radar techniques. The old way of making maps is to cover the ground on foot, establish datum lines, sometimes of great length, and base triangulations and levelings on these lines. This method makes for great accuracy; but it takes a long time and the cost is high, particularly if dense forests and precipitous mountains make the going difficult. The modern method is to photograph the ground from airplanes, piece the photographs together, and make the map from the resulting composite picture. But such a map is not accurate unless the photographs are referred to a system of points on the ground whose positions are fixed with precision. That is where radar comes in.

Radar survey methods are now used in both the great African continent and in New Zealand. In New Zealand the main purpose of the radar survey is to add contour lines and other details to existing maps, but in Africa the object is to produce, at the rate of at least 100,000 square miles a year, accurate maps of huge tracts of country of which nothing more than a rough survey has been made so far.

The radar beacon is one of the most

(Continued on page 69)



This novel antenna was used first for radar.

The New Model 777

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- **D.C. VOLTS: (at 20,000 Ohms Per Volt) 0 to 7.5/15/75/150/750/1,500 Volts**
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- **DECIBELS: (Based on zero decibels equals .006 Watts into a 500-Ohm line.) —10 to + 18 db., + 10 to + 38 db., + 30 to + 58 db.**

Model 777 operates on 90-120 Volts 60 cycles A.C. Housed in beautiful hand-rubbed cabinet. Complete with test leads, tubes, charts and detailed operating instructions. Size 13" x 12½" x 6".

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Bill Erwin Radio Co., 926 First Ave., Gadsden, Ala.
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Capitol Radio Wholesalers, 2120 14th St., N. W., Washington, D. C.
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Sun Radio of Washington, D. C., 938 F. St., N. W., Washington, D. C.

ILLINOIS
Belmont Radio Supply, 1921 W. Belmont St., Chicago 13, Ill.
Crescent Radio Components, 4324 W. Fullerton Ave., Chicago 39, Ill.
Radio Doctors' Supply House, 220 East Station, Kankakee, Ill.
Lofgren Motorola Distributing Co., 1202 4th Ave., Moline, Ill.
Hombach Supply Co., 2009-30th St., Rock Island, Ill.

INDIANA
Radio Service Headquarters, 725 S. Main St., Elkhart, Ind.
Van Sickle Radio Supply Co., 34 W. Ohio, Indianapolis 4, Ind.
Clingaman Radio, 814 W. Main St., Peru, Ind.

KANSAS
Overton Elec. Co., Inc., 522 Jackson St., Topeka, Kansas

MASSACHUSETTS
Radio Shack Corp., 167 Washington St., Boston, Mass.
Harolds Radio Distributors, 46 Brattle St., Boston, Mass.
Springfield Sound Co., 147 Dwight St., Springfield 3, Mass.

MICHIGAN
Mark's Stores, Inc., 1333 Broadway, Detroit 26, Mich.
Fulton Radio Supply Co., 265 W. Cortland St., Jackson, Mich.
Electric Products Sales Co., 427 E. Michigan Ave., Lansing 29, Mich.
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MARYLAND
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MISSOURI
Tri-State Radio & Supply, 136 Bartlet St., Poplar Bluff, Mo.
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Arbor Co., 823 Central Ave., Nebraska City, Nebr.
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General Radio Supply, 207 N. Broadway, Camden, N. J.
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Scheller Radio Co., 262 Oak St., Buffalo 3, N. Y.
C. A. Winchell Radio Supply Co., 37 Central Ave., Cortland, N. Y.
W. Rd. Radio Laboratory, 6 Hamilton Ave., Croton-on-Hudson, N. Y.
F. C. Harrison Co., 108 W. Church St., Elmira, N. Y.
Arace Brothers, 562 Broadway, Kingston, N. Y.
Metropolitan Elect. & Dist. Co., 42 Warren St., New York 7, N. Y.
Brooks Radio Distributing Corp., 80 Vesey St., New York 7, N. Y.
Arrow Electronics, 82 Cortlandt St., New York 7, N. Y.
General Electronic Dist. Co., 98 Park Pl., New York 7, N. Y.
Legri S. Co., Inc., 846 Amsterdam Ave., New York 25, N. Y.
National Radio Dist., 899 So. Blvd., New York 59, N. Y.
Moss Electronic Distributing Co., 229 Fulton St., New York 7, N. Y.
Roy C. Stage, 265 Erie Blvd., West, Syracuse, N. Y.
Trojan Radio Co., 436 River St., Troy, N. Y.

NEW MEXICO
Supreme Radio Supply, 129 West 2nd St., Roswell, N. M.

NORTH CAROLINA
Eastern Radio Supply, 459 Hay St., Fayetteville, N. C.

OHIO
Olson Radio Warehouse, Inc., 73 East Mill St., Akron, Ohio
Olson Radio Warehouse of Cleveland, 2020 Euclid Ave., Cleveland, Ohio
Progress Radio Supply Co., 413 Huron Road, Cleveland 15, Ohio
Whitehead Radio Co., 120 East Long St., Columbus 15, Ohio
Lifetime Sound Equipment Co., 911 Jefferson Ave., Toledo, Ohio
Steward Electric Service, 116 Seroto St., Urbana, Ohio

PENNSYLVANIA
The Spence Electric Store, 1210 12th Ave., Altoona, Pa.
Williams Auto Sales Co., Clearfield, Pa.
Kratz Bros., Kohn & Oak Sts., Norristown, Pa.
Nat Lazar Radio Co., 42-41 Lancaster Ave., Philadelphia 4, Pa.
Alms Radio Co., 509 Arch St., Philadelphia 6, Pa.
Barnett Bros. Radio Co., 145 N. 7th St., Philadelphia 6, Pa.
Radio 437 Store, 437 Market St., Philadelphia 6, Pa.
M & H Sporting Goods Co., 512 Market St., Philadelphia 6, Pa.
Warner Radio Co., 631 Market St., Philadelphia 6, Pa.
Lectronic Research Laboratories, 5832 Hegerman St., Philadelphia 24, Pa.
York Radio & Refrigeration Parts, 265 W. Market St., York, Pa.
J. R. S. Distributors, 644 W. Market St., York, Pa.

SOUTH CAROLINA
Bates Radio & Supply Co., 7 South Main St., Greenville, S. C.

TENNESSEE
Chemcity Radio & Electric Co., 12 Emory Park, Knoxville 17, Tenn.
Bermitage Music Co., 423 Broad St., Nashville 3, Tenn.

TEXAS
Electronic Equipment & Engineering Co., 1322½ S. E. Elizabeth St., Brownsville, Texas
Electronic Equipment & Engineering Co., 1310 S. Staples St., Corpus Christi, Texas
Paul Blackwell Co., 2016 Richardson St., Dallas 1, Texas
Wilkinson Bros., 2406 Ross St., Dallas, Texas
Car Parts Depot, Inc., 721 Texas St., El Paso, Texas
Mission Radio, Inc., 814 S. Presa St., San Antonio 5, Texas
The Hargin Company, Inc., 1305 Austin Ave., Waco, Texas

VIRGINIA
Ashman Dist. Co., 807 Granby St., Norfolk 10, Va.
D. R. Johnston Co., 1315 East Cary St., Richmond 19, Va.
Mattson's Radio, 519-21-23 W. Broad St., Richmond 22, Va.

WASHINGTON
White's Htg. Radio & Appliance Store, W. 908 First Ave., Spokane 8, Wash.

WISCONSIN
Valley Radio Distributors, 518 N. Appleton St., Appleton, Wisc.
Standard Radio Parts Co., 1244 State St., Racine, Wisc.

MANUFACTURED BY **SUPERIOR INSTRUMENTS CO.** **227 FULTON STREET NEW YORK 7, N. Y.**

FM STATION LIST

RADIO-CRAFT presents this month its first list of FM radio stations of the United States. It has not been practical to print such a list in earlier issues, as the number of FM stations was increasing so rapidly that any such list would have been almost useless by the time it could be printed. This list is complete as of February 25, 1948.

In addition to those below, there are also 38 non-commercial FM stations between 88 and 92 mc, on which information is not immediately available. We hope to include all these in the June list.

New stations are still coming on the air daily, but the initial rush is over, and we believe it will be possible from now on to keep a reasonably up-to-date list. To this end, we will print revised lists as often as necessary—every other month for a time. Shortwave station data will appear in alternate issues.

Stations are listed by frequencies for easy identification. A listener may not always hear the call letters perfectly, but can always note the frequency of an unknown station on the dial of his own receiver. As many stations announce their channel numbers, a conversion table of frequencies and channel numbers is printed on this page.

FREQUENCY (MC)	CALL	LOCATION
44.1	W2XMN	Alpine, N. J.
90.5	KWGS-FM	Tulsa, Okla.
92.1	KLZ-FM	Denver, Colo.
92.1	W2XEA	Alpine, N. J.
92.3	KUMB	Des Moines, Iowa
92.3	KVNJ-FM	Fargo, N. D.
92.3	WCOH-FM	Newnan, Ga.
92.3	WCOL-FM	Columbus, Ohio
92.3	WDUL	Duluth, Minn.
92.3	WEBC-FM	Superior, Wisc.
92.5	KCMC-FM	Texarkana, Texas
92.5	KYW-FM	Philadelphia, Pa.
92.5	WFRS	Grand Rapids, Mich.
92.5	WGOV-FM	Valdosta, Ga.
92.5	WINC-FM	Winchester, Va.
92.5	WMBD-FM	Peoria, Ill.
92.9	KDKA-FM	Pittsburgh, Pa.
92.9	KGDM-FM	Stockton, Calif.
92.9	KOAD-FM	Omaha, Neb.
92.9	KONO-FM	San Antonio, Tex.
92.9	WBNY-FM	Buffalo, N. Y.
92.9	WBUR-FM	Burlington, Iowa
92.9	WBZ-FM	Boston, Mass.
92.9	WEEU-FM	Reading, Pa.
93.1	KWBW-FM	Hutchinson, Kan.
93.1	WAIR-FM	Winston-Salem, N. C.
93.1	WFBL-FM	Syracuse, N. Y.
93.1	WHYN-FM	Holyoke, Mass.
93.1	WJBK-FM	Detroit, Mich.
93.1	WKAT-FM	Miami Beach, Fla.
93.1	WKBH-FM	La Crosse, Wisc.
93.3	WGBR-FM	Goldsboro, N. C.
93.3	WIP-FM	Philadelphia, Pa.
93.3	WJTN-FM	Jamestown, N. Y.
93.3	WKPB	Knoxville, Tenn.
93.3	WKYC	Paducah, Ky.
93.3	WRBL-FM	Columbus, Ga.
93.3	WTMJ-FM	Milwaukee, Wisc.
93.5	KOCS-FM	Ontario, Calif.
93.7	KRFM	Fresno, Calif.
93.7	KXOK-FM	St. Louis, Mo.
93.7	WCSI	Columbus, Ind.
93.7	WLAW-FM	Lawrence, Mass.
93.7	WSGN-FM	Birmingham, Ala.
93.9	KSPI-FM	Stillwater, Okla.
93.9	WCOU-FM	Lewiston, Maine
93.9	WNYC-FM	New York, N. Y.
93.9	WRC-FM	Washington, D. C.
94.1	KERN-FM	Bakersfield, Calif.
94.1	WGST-FM	Atlanta, Ga.
94.1	WHBC-FM	Canton, Ohio.
94.1	WIBG-FM	Philadelphia, Pa.
94.1	WKOK-FM	Sunbury, Pa.
94.1	WMIX-FM	Mt. Vernon, Ill.
94.1	WEAU-FM	Eau Claire, Wisc.
94.3	WDRC-FM	Hartford, Conn.
94.3	WGUY-FM	Bangor, Maine
94.3	WJLK-FM	Asbury Park, N. J.
94.5	KAMT-FM	College Station, Texas.
94.5	WIS-FM	Columbia, S. C.
94.5	KGKL-FM	San Angelo, Texas
94.5	WMLL	Evansville, Ind.
94.5	WMOT-FM	Pittsburgh, Pa.
94.5	WNDB-FM	Daytona Beach, Fla.
94.5	WSYR-FM	Syracuse, N. Y.
94.7	KOCY-FM	Oklahoma City, Okla.
94.7	KROC-FM	Rochester, Minn.
94.7	WAPO-FM	Chattanooga, Tenn.
94.7	WENR-FM	Chicago, Ill.
94.7	WMAS-FM	Springfield, Mass.
94.7	WMCP	Baltimore, Md.
94.9	KAKC-FM	Tulsa, Oklahoma
94.9	KFPW-FM	Fort Smith, Ark.
94.9	KING-FM	Seattle, Wash.
94.9	KSFH	San Francisco, Calif.
94.9	WABW	Indianapolis, Ind.
94.9	WCMW-FM	Canton, Ohio
94.9	WMRC-FM	Greenville, S. C.
94.9	WQAM-FM	Miami, Fla.
94.9	WWCF	Greenfield, Wisc.
94.9	KSCJ-FM	Sioux City, Iowa
95.1	KFXM-FM	San Bernardino, Calif.
95.1	WEW-FM	St. Louis, Mo.
95.1	WGBA-FM	Columbus, Ga.
95.1	WGPA-FM	Bethlehem, Pa.
95.1	WHBS-FM	Huntsville, Ala.
95.1	WRXW	Louisville, Ky.
95.1	WTRF-FM	Bellaire, Ohio.
95.1	WTMA-FM	Charleston, S. C.
95.3	KGBS-FM	Harlingen, Texas
95.3	KSJO-FM	San Jose, Calif.
95.3	WSRS-FM	Cleveland Heights, Ohio
95.5	KECA-FM	Los Angeles, Calif.
95.5	KRBA-FM	Lufkin, Texas
95.5	KPRA	Portland, Oregon
95.5	WBGE-FM	Atlanta, Ga.
95.5	WDLM	Chicago, Ill.
95.5	WHPE-FM	High Point, N. C.
95.5	WPAM-FM	Pottsville, Pa.
95.6	WKNB-FM	New Britain, Conn.
95.7	WMMW-FM	Meriden, Conn.
95.7	WMUR-FM	Manchester, N. H.
95.7	WTPS-FM	New Orleans, La.
95.9	WEMZ	Allentown, Pa.
96.1	WBCM-FM	Bay City, Mich.
96.1	KCRA-FM	Sacramento, Calif.
96.1	KFMX	Council Bluffs, Iowa
96.1	KLCN-FM	Blytheville, Ark.
96.1	WMBH-FM	Joplin, Mo.
96.1	WOHS-FM	Shelby, N. C.
96.1	WOWO-FM	Fort Wayne, Ind.
96.1	WTAG-FM	Worcester, Mass.
96.3	KRKD-FM	Los Angeles, Calif.
96.3	WBIK	Chicago, Ill.
96.3	WINX-FM	Washington, D. C.
96.3	WJCM-FM	Rice Lake, Wisc.
96.3	WQXR-FM	New York, N. Y.
96.5	KRON	San Francisco, Calif.
96.5	KSEI-FM	Pocatello, Idaho
96.5	KXYZ-FM	Houston, Texas
96.5	WGH-FM	Norfolk, Va.
96.5	WHEF-FM	Rochester, N. Y.
96.5	WTIC-FM	Hartford, Conn.
96.7	WBUZ	Bradbury Heights, Md.
96.7	WEAW	Evanston, Ill.
96.7	WSTC-FM	Stamford, Conn.
96.7	WVAW-FM	Cheviot, Ohio.
96.9	KCRK	Cedar Rapids, Iowa
96.9	KFBK-FM	Sacramento, Calif.
96.9	KRBC-FM	Abilene, Texas
96.9	WEBR-FM	Buffalo, N. Y.
96.9	WIBX-FM	Utica, N. Y.
96.9	WJHP-FM	Jacksonville, Fla.
96.9	WLAN-FM	Lancaster, Pa.
96.9	WLAV-FM	Grand Rapids, Mich.
96.9	WOPI-FM	Bristol, Tenn.
96.9	WPAD-FM	Paducah, Ky.
96.9	WXHR-FM	Cambridge, Mass.
97.1	KKLA	Los Angeles, Calif.
97.1	KPFM-FM	Portland, Oregon
97.1	KTUL-FM	Tulsa, Okla.
97.1	WASH	Washington, D. C.
97.1	WBZA-FM	Springfield, Mass.

FM frequencies and channel numbers

Channel No.	mc.	Channel No.	mc.	Channel No.	mc.	Channel No.	mc.
201	88.1	226	93.1	251	98.1	276	103.1
202	88.3	227	93.3	252	98.3	277	103.3
203	88.5	228	93.5	253	98.5	278	103.5
204	88.7	229	93.7	254	98.7	279	103.7
205	88.9	230	93.9	255	98.9	280	103.9
206	89.1	231	94.1	256	99.1	281	104.1
207	89.3	232	94.3	257	99.3	282	104.3
208	89.5	233	94.5	258	99.5	283	104.5
209	89.7	234	94.7	259	99.7	284	104.7
210	89.9	235	94.9	260	99.9	285	104.9
211	90.1	236	95.1	261	100.1	286	105.1
212	90.3	237	95.3	262	100.3	287	105.3
213	90.5	238	95.5	263	100.5	288	105.5
214	90.7	239	95.7	264	100.7	289	105.7
215	90.9	240	95.9	265	100.9	290	105.9
216	91.1	241	96.1	266	101.1	291	106.1
217	91.3	242	96.3	267	101.3	292	106.3
218	91.5	243	96.5	268	101.5	293	106.5
219	91.7	244	96.7	269	101.7	294	106.7
220	91.9	245	96.9	270	101.9	295	106.9
221	92.1	246	97.1	271	102.1	296	107.1
222	92.3	247	97.3	272	102.3	297	107.3
223	92.5	248	97.5	273	102.5	298	107.5
224	92.7	249	97.7	274	102.7	299	107.7
225	92.9	250	97.9	275	102.9	300	107.9

WANTED: FM SCOUTS

FM is a new art in Radio. Much of it remains to be learned by engineers. The behavior of radio waves in the FM band is still understood imperfectly. According to theory, FM signals should not reach much beyond the horizon. Yet often they do. In some cases extraordinary DX reception has been reported.

RADIO-CRAFT readers can render the radio art a distinct service in reporting such phenomena as well as others, to us regularly. We will publish such information as well as the "FM Scout's" name in this department, beginning with the June issue. Address all letters to FM Department, c/o this magazine.

THE EDITORS.

(Continued on page 73)

Now! BIG RECEIVER QUALITY IN THE LOW-PRICED FIELD!!

THE NEW NATIONAL NC-33

$65.95

AMATEUR NET

Here's the receiver you've been waiting for! A real communication receiver covering all frequencies from 500 kcs to 35 mcs, the brand new NC-33 offers the same fine workmanship that distinguishes National's more expensive receivers. Dollar for dollar, feature for feature, it's better built, better looking, better performing! See it — compare it — today at your dealer's. You'll decide it's the perfect choice for your shack, living room, playroom or den!

- Operates from 110-120 volts AC or DC. Ideal for shipboard and other uses where DC only is available.
- Electrical bandspread on all bands! Broadcast, amateur, police and foreign bands plainly marked.
- Automatic noise limiter assures optimum reception under all operating conditions.
- CW oscillator with pitch control provides superb CW reception.
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Gentlemen: Please send me your new 1948 catalog of National receivers, components and parts.

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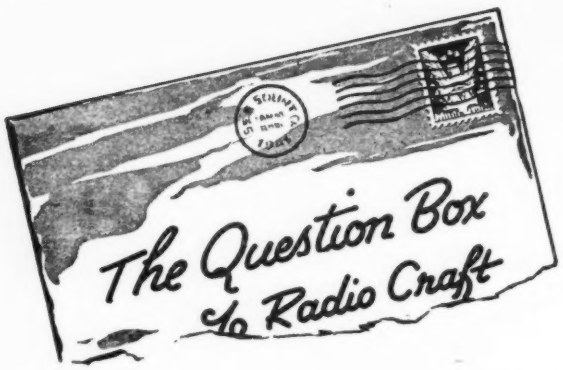
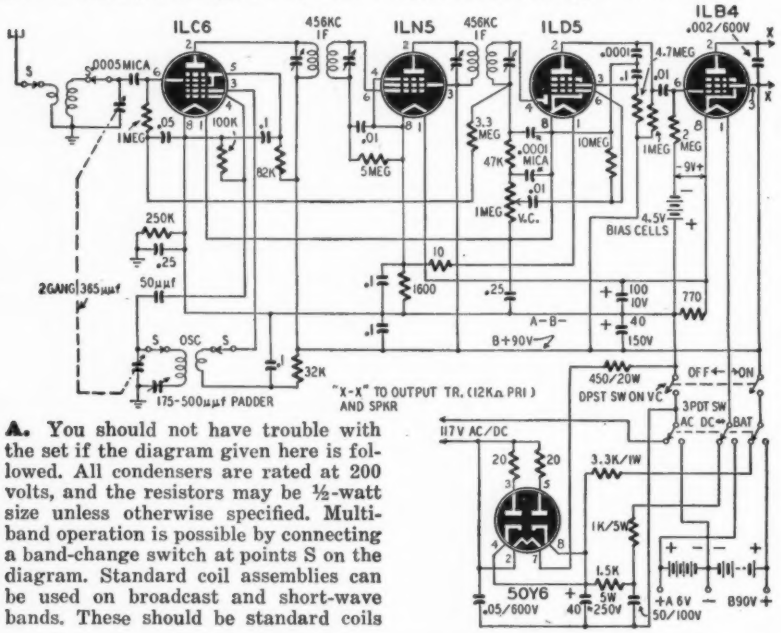


Question Box queries will be answered by mail and those of general interest will be printed in the magazine. A fee of 50c will be charged for simple questions requiring no schematics. Write for estimate on questions that may require diagrams or considerable research. Six to 8 weeks is required to draw up answers involving large schematics.

THREE-WAY PORTABLE RECEIVER

I want to build a 3-way portable radio using a 1LC6, 1LN5, 1LD5, 1LB4, and a 5OY6. Please print a suitable diagram.—J.C.A., Randolph Field, Texas.

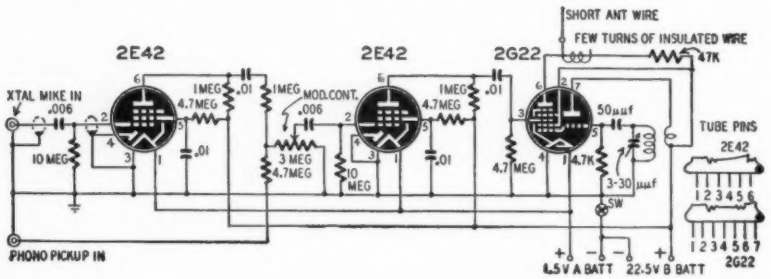


A. You should not have trouble with the set if the diagram given here is followed. All condensers are rated at 200 volts, and the resistors may be ½-watt size unless otherwise specified. Multiband operation is possible by connecting a band-change switch at points S on the diagram. Standard coil assemblies can be used on broadcast and short-wave bands. These should be standard coils sold for use with 365-µµf capacitors. The padder should then be the capacity specified by the manufacturer, if it differs from the 175-500 µµf shown here.

PHONOGRAPH OSCILLATOR

Please design a phono oscillator using subminiature tubes and hearing-aid batteries. I would like to use it with a crystal mike or crystal pickup. I want the unit to tune to the high-frequency end of the broadcast band.—M.K., Philadelphia, Pa.

A. Your specifications for a phono oscillator are met in this design. The smallest available components should be used to make a compact unit. The oscillator coil is wound on a ⅜-inch form. The grid coil has 180 turns of No. 34 enameled wire, jumble-wound to occupy 3/16 inch. The plate or tickler coil has about 30 turns of No. 34 enameled wire, spaced 1/16 to ⅛ inch from the lower end of the grid coil. The position and number of turns on the tickler should be varied for best operation.



I.F.'S FOR FM

Why was the i.f. of FM receivers changed from 4.3 to 10.7 mc when new bands were established? A.F.C., Waverly, Wis.

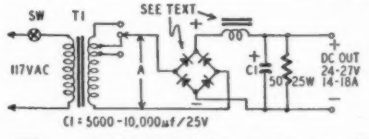
A. To eliminate image interference. The image frequency is twice the i.f. away from the signal frequency. With a 4.3-mc i.f., the image of an 88-mc signal is 96.6 mc which is within the band. With a 10.7 mc i.f., the image is outside the band at 109.4 mc where it cannot cause interference.

This was the reason the older 175-kc intermediate frequency for broadcast receivers was abandoned for the higher 465-kc frequency.

24-VOLT SUPPLY

I would like a diagram of a power supply delivering 24 to 28 volts d.c. at 14 to 18 amperes. This is to be used to operate Army surplus radio equipment.—D.L.R., Hornell, N. Y.

A. A full-wave bridge rectifier is used in this supply to deliver the required current and voltage. A number of different types of dry rectifiers can be used for the job, and the a.c. input voltage, A should not exceed manufacturer's specifications for the rectifier you select. The primary of the transformer should have a 750-volt-ampere rating. The primary and secondary may be tapped to permit voltage adjustment as the rectifier ages.



The capacitance of the condenser will depend on the amount of filtering needed. The choke has an inductance of .005 henry and 0.6-ohm d.c. resistance. It may be made by winding 64 turns of No. 11 single-cotton enameled wire on a 1½ x 1½-inch (2¼-square inch) core. The air gap, about 0.018 inch, should be adjusted for best results.

Transformers of the type specified are seldom available commercially and may have to be wound to specifications. Substitutes can be made by connecting the secondaries of several high-current filament transformers in series to get the required voltage for the rectifier unit.

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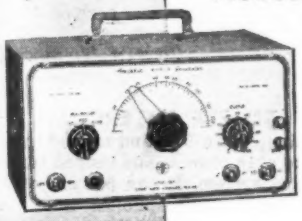

The ideal matching instrument to the Heathkit Oscilloscope for advanced service technique in television and FM servicing. Supplies sine or square wave 20 cycles to 20,000 cycles. Excellent wave form and extremely low distortion. Everything supplied. Grey crackle cabinet, beautiful two color calibrated panel, 5 tubes, 110V power transformer, 1% calibrating resistors, all other parts and detailed blueprints and instructions.

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Features

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- Beautiful two color panel.
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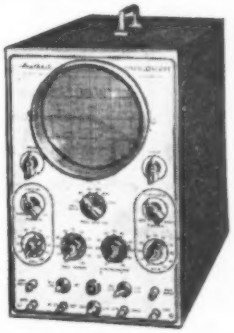
- Ideal for television and radio trouble shooting.
- Convenient portable size—weighs only 26 pounds.
- Cabinet dimensions 8½" x 13" high by 17" deep.
- Provision for external synchronization.
- Test voltage post on front panel.
- Deflection sensitivity .65 volts per inch full gain.
- Frequency response plus or minus 20% from 50 cycles to 50 KC.
- Input impedance 1 megohm and 50 MMF.
- Tubes supplied: 2 6SJ7, 2 5Y3, 1 884, 1 5BP1.
- Operates from 110 volt 60 cycle AC.
- Power supply delivers 1100 volts negative, 350 volts positive, making 1450 volts available for the CR tube.
- All oil filled condensers used, assuring long life.



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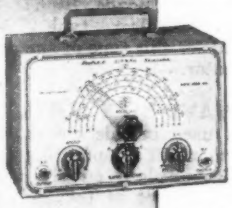
HEATHKIT SIGNAL GENERATOR KIT



Features

- 110 Volt 60 cycle operation with transformer power supply.
- Completely isolated from power line.
- Can be used on any type receiver.
- Supplies fundamentals from 150 KC to 34 MC in five bands.
- Useful harmonics to over 100 MC.
- 400 cycle audio frequency modulation available separately for audio testing.
- Supplies either pure RF or modulated signal.
- Highly accurate calibration with calibration adjustment for exact frequency.
- Approximately 30% modulation.
- Uses 6SN7 as oscillator and audio frequency amplifier and 6X5 as transformer power supply rectifier.

$1950

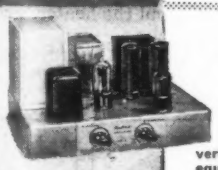
Shipping Wt. 7 lbs. Convenient, portable—Dimensions 9"x 6" x 4¾" deep, weight 4½ lbs. Complete with detailed blueprints which enable the constructor to assemble an instrument he will be proud to own.

The NEW HEATHKIT VACUUM TUBE VOLTMETER KIT

The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for $75.00 or more. Features 500 microamp meter, transformer power supply, 1% glass enclosed divider resistors, ceramic selector switches, 11 megohms input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6H6 as AC rectifier and 6X5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time less than four pleasant hours, and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC or DC. Ohmmeter has ranges of scale times 1, 100, 1000, 10M and 1 megohm, giving range .1 ohm to 1000 megohms. Complete with detailed instructions. Add postage for 8 lbs.

$2450

HEATHKIT HIGH FIDELITY AMPLIFIER KIT



Build this high fidelity amplifier and save two-thirds of the cost. Push pull output using 1619 tubes (military type 6L6's), two amplifier stages using a dual triode (6SN7), and a phase inverter give this amplifier a linear reproduction equal to amplifiers selling for ten times this price. Every part supplied; punched and formed chassis, transformers (including quality output to 3-8-15 ohm voice coil), tubes, controls, and complete instructions. Add postage for 20 lbs. 12" PM speakers for above.....$6.95

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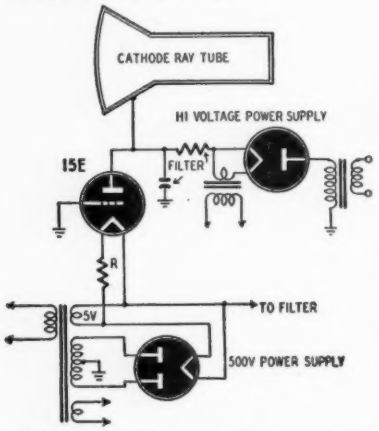
RADIO·ELECTRONIC CIRCUITS

TV CAPACITOR DISCHARGER

The bright spot appearing on television screens after the set is turned off is due to the charge remaining on the high-voltage filter condenser. A simple, inexpensive method of removing the charge uses a 15E tube.



The plate of the tube is connected to the high-voltage power supply, but draws no current because the tube is cut off by the high bias voltage. As soon as the power is turned off, the bias voltage drops rapidly to below cutoff before the 15E filament has cooled off appreciably. The tube then conducts and quickly discharges the high-voltage condenser through the low-voltage bleeder.

To prolong the tube life, use a 1.2-ohm, 5-watt resistor to drop the filament voltage to about half its value. If the 5-volt supply cannot furnish the additional current, use a separate 2.5-volt transformer.

Any other high-voltage tube may be used if the 15E is not available. Cutoff bias can be found by dividing the plate voltage by the amplification factor.

RICHARD H. HOUSTON,
Washington, D. C.

AUDIO OSCILLATOR

Designed for classroom use, this simple audio oscillator uses a push-pull output transformer as the tank coil of a Hartley oscillator. The output frequency is close to 1,000 cycles, but can be changed by either juggling the values or switching condensers across the output transformer primary.

Any triode with a 0.3-ampere filament and grid and plate tied together, or a 25Z5, can be used as a half-wave rectifier, and a 40-watt lamp drops the line voltage to the right value for the tube filaments.

The values are not critical and the whole unit can be built into a small cabinet.

GLENN KETCHNIE,
Blyth, Ontario

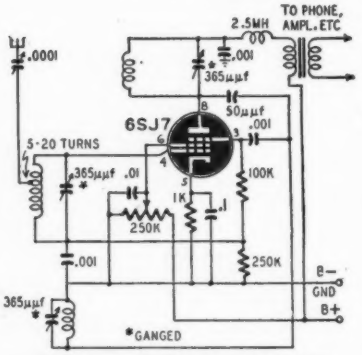
SUPER REFLEX RECEIVER

The reflex receiver shown uses a single 6SJ7 and has r.f. feedback from both the plate and the suppressor grid, giving very great amplification. Detection takes place in the suppressor-grid circuit, and the audio is amplified in the plate circuit.

The coils are close-wound adjacent to each other with No. 30 d.s.c. wire on a 2-inch diameter form and have 70 turns each.

If the set overloads on strong signals, adjust the 250,000-ohm volume control for best reception.

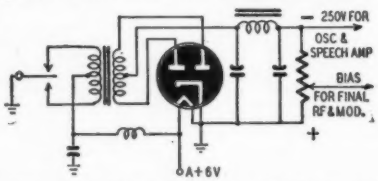
ROBIN TUCKER,
Montreal, Quebec



NOVEL POWER SUPPLY

Here is a simple way of getting the most output with the least battery drain in a car transmitter.

Use a 250-volt Vibropack to power the oscillator and speech amplifier, and a 500-volt dynamotor to power the r.f. amplifier and modulator. But, instead of



grounding the negative terminal, ground the positive lead. Now the Vibropack can supply bias voltage to the r.f. amplifier and modulator and still leave the full 250 volts for the speech amplifier and oscillator.

Some of the advantages of this system are:

1. Bias voltage does not subtract from the voltage available to the oscillator and speech amplifier.

2. There is no power loss in dropping resistors from high voltage supply for oscillator and speech amplifier use.

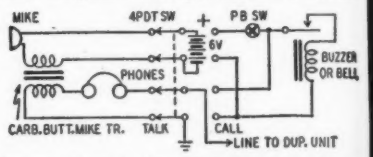
3. There is no loss of high voltage due to cathode resistor, either in the r.f. or modulator stages.

4. The oscillator plate-tuning condenser can be grounded without using parallel feed, since the positive on the Vibropack is grounded.

ZOLTAN T. BOGAR,
Laurel, Maryland

SIMPLE INTERCOM

A single-wire line and a good ground are the only connections needed for this intercom system. It can be easily made with surplus microphones and head-



phones. To call the other station, throw the switch to the call position, press the button, and throw the switch back to the talk position.

When not in use, both switches should be in the call position.

RICHARD HERMAN,
Chicago, Illinois.

(A surplus handset, type TS-15, would be ideal for this type of simple intercommunicator.—*Editor*)

FULL-WAVE BIAS SUPPLY

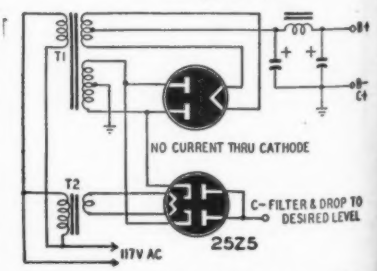
A 25Z5 is used in this circuit as a full-wave bias rectifier operating from the high-voltage plate supply transformer. The cathodes of the 25Z5 are connected to the plates of the high-voltage rectifier tube.

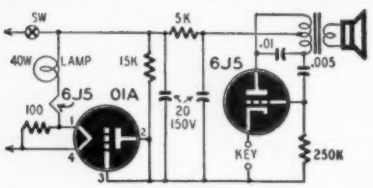
In operation, current flows through the cathode attached to the plate of the main rectifier which is not conducting at the time.

The filament transformer for the 25Z5 can be replaced with a 290-ohm, 5-watt resistor to drop the line voltage to 25.

This bias supply should not have more than 245 volts r.m.s. applied to the cathodes to prevent breakdown between the cathode and the heater, which might otherwise occur.

JOHN KWIETINSKAS,
Duquesne, Pa.





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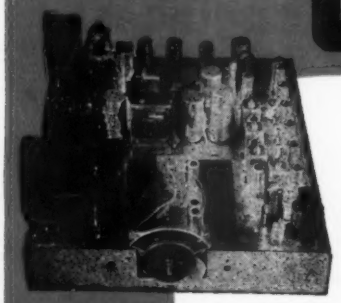
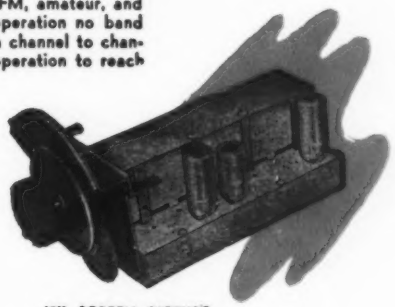
Champion Models with

DUMONT INPUTUNER



The Dumont Imputuner tunes continuously from 44 to 216 megacycles without a break, covers all 13 channels as well as FM, amateur, and aviation channels. For ease and convenience of operation no band switching of any kind is required when tuning from channel to channel with the imputuner system. Just one simple operation to reach any desired station.



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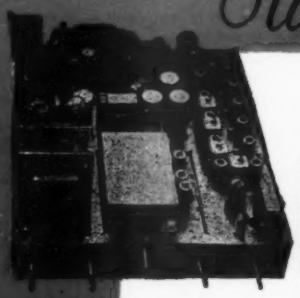

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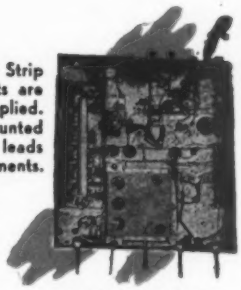

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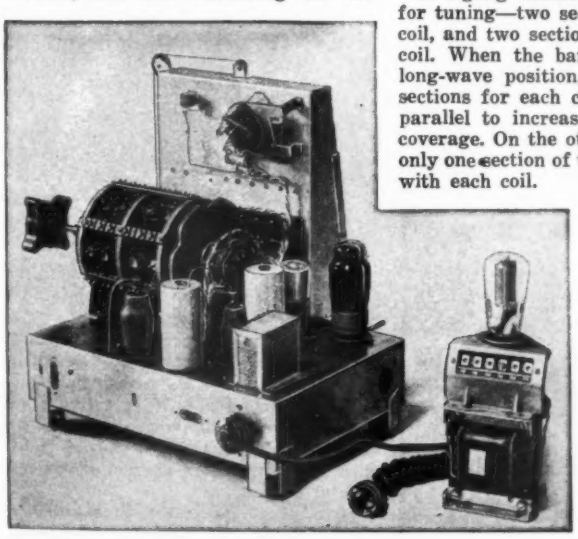
FREE BOOK

European Band-Change System

By D. E. RAVALICO

AN INTERESTING type of receiver, this Italian model, is basically a 4-tube superheterodyne, but is novel because a rotating coil turret is used to switch the different coils into the circuit. The photograph of the chassis shows the band-switch turret rather well.

The band switch is divided into two sections, one half containing the antenna and mixer coils, and the other half the oscillator coil. Five wiping contact points on each section connect the coils to the various circuits. (This system is similar to the one used in the Meissner Signal-Shifter.)



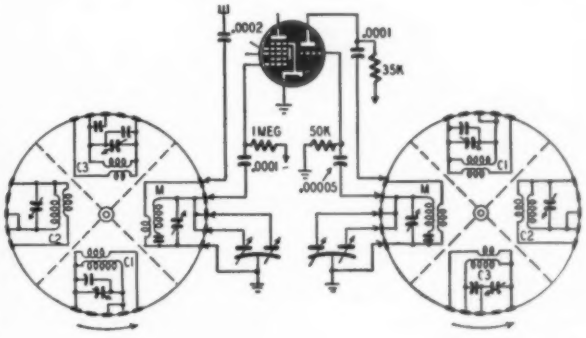
A 4-gang variable condenser is used for tuning—two sections for the mixer coil, and two sections for the oscillator coil. When the band switch is in the long-wave position, the two condenser sections for each coil are connected in parallel to increase the low-frequency coverage. On the other bands, however, only one section of the condenser is used with each coil.

Unlike American sets, the band-switch knob is on the side of the cabinet.

Only the mixer-oscillator tube and the coil-switching circuit are shown in the diagram, the rest of the receiver circuit being conventional.

The receiver operates on a.c. on any line voltage from 110 to 275 by means of a specially tapped power transformer. The power transformer and rectifier are a separate unit which is connected to the receiver by a power cable. The d.c. filter is on the receiver chassis. A separate loudspeaker plugs into terminals on the chassis.

An electron-ray indicator tube near the top of the dial is used as a tuning indicator.



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Motor Driven GEAR BOX; two 24v DC shunt wound motors; can be used as low voltage AC motor from 8 to 24v input; complete with micro switch, 50 gears and control box. Brand New..... $3.50

BC357 RECEIVER complete with tubes, highly sensitive relay. Operates on 4/10 mil., can be converted to 2½ to 6 and 10 meter receiver. Price $2.50

STANDARD LIP MICROPHONE T-45—complete with PL291-A plug; ready for use. Instruction book included. Brand New 25c

THROAT MIKE T-30—double throat type; PL-291 plug. M199 neckband. Works into any 200 ohm impedance input circuit. Instruction sheet included 39c

HS-23 HEADSET—8000 ohm impedance, PL-54 plug 98c

HS-33 HEADSET—600 ohm impedance 98c

KELLOGG operator transmitter carbon microphone T-28E; adjustable swivel and extension bracket, with special 10 ft. ES2526-8 cord. Brand New $7.95

EARPHONE RECEIVERS R-11—high impedance light weight watch case type, double magnet, black bakelite cap; with PL-54 plug..... 98c

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HANDMIKE T-17B—200 ohm, single button carbon mike, push buttton switch. Ideal for home transmitter or portable rig; 5 ft. rubber cord, PL-68 plug and dust cover. Brand New 89c

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HANDSET TS-13A—200 ohm, same as above can be used in intercom, radio & telephone work $1.98

HANDSET TS-9AP. 75 ohm imp. 6' cord. Brand New..... $2.50

R-37 ARN5 RECEIVER 11 tubes, 3 xtals; 326 to 335 Mc. Brand New $14.95

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TBX 2-3-6 NAVY MODEL TRANSMITTER RECEIVER versatile because of freq. range of 2 Mc to 4.5 Mc for transmitter and 2 Mc to 8 Mc for receiver. It's adaptable for various types of power supplies, such as 6v-12v-24v dynamotor and 110v AC powerpacks. This unit is excellent for ship to shore and ship to ship communication. Range 30 miles CW and 15 miles phone. Complete with tubes and crystals without cabinets $29.95

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FIELD TELEPHONE RM-29 with handset, generator, ringer &c., in strong steel case. Brand New $14.95

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SA-260U—Beautiful black plastic microphone switch; 2½" long, 1" diameter; push button make and break, press to signal. Screw type, can be used with or without case. Good for interoffice buzzer, closet lights, doorbells, phonograph recorder. Can be mounted or used by hand. Each.. 26c

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TECHNOTES

. . . . MECK TRAIL-BLAZER

New sets using miniature tubes may have considerable hum at low volume. The B-voltage is too high, causing the oscillator to produce a strong signal which results in interference from the short-wave bands. Both of these troubles may be eliminated by connecting a 75- to 100-ohm, 1-watt resistor between the 35W4 cathode and the input filter condenser.

H. R. NEWELL,
Bradford, N. H.

. . . . HAMMARLUND HQ-129 X

The defect in this receiver was progressive loss of signal in the first stage over a period of time. This was due to particles of metal from the switch contacts being deposited on the insulating material of the switch and partially short-circuiting the coil. Measuring across the switch with the coil not in circuit, a resistance of 50 ohms was found.

To repair the set, I applied high voltage from the power supply across the switch. This eliminated the partial short circuit.

ALVA H. CLARK,
Tarboro, N. C.

. . . . PHILCO 46-806

Complaint: distortion and fading. To eliminate this trouble, replace the .006 paper coupling condensers in the audio stages (C-200 and C-202 on manufacturer's diagram) with mica condensers of the same capacitance. Usually only one of these condensers is defective, but replacing both will prevent any further trouble.

R. V. BLIKFONTEIN,
South Africa

. . . . I.F. INTERFERENCE

Interference from marine radio stations, whose signal frequencies are close to the intermediate frequency of a receiver, may be eliminated by connecting half of an i.f. transformer in series with the antenna. The i.f. coil and trimmer condenser form a parallel-resonant wave trap which, when tuned to the interfering signal, should eliminate it completely.

R. N. HORAN,
Poughkeepsie, N. Y.

. . . . GE MODEL 50 RADIO CLOCK

A common complaint about these radios is that the power switch cannot be turned to the radio position. The trouble in this case is cleared up by merely putting a drop of oil on the cam that operates the switch contacts.

JACK C. WHITE,
Jackson, Miss.

. . . . HUNTING INTERMITTENTS

When servicing intermittent sets that cut out after long periods of time or unexpectedly, a 250-watt heat lamp may be used to open up the defective component. Concentrate the heat from the lamp on different parts of the set. Take care that condensers are not ruined by excessive heat.

ANDY R. HARCAR,
Birdsboro, Penna.

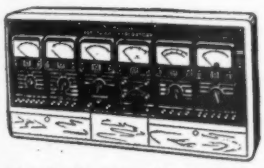
NEW RADIO·ELECTRONIC DEVICES

METER PANEL

Simpson Electric Co.
Chicago, Ill.

The Mode. 1005 electrical laboratory combines the functions of over 60 separate instruments. It consists of 6 individual 4½ inch rectangular instruments, each with a complete set of ranges.

In addition to a.c. and d.c. voltage and current ranges, a multirange ohmmeter and a single-phase wattmeter have been included. For extreme sensitivity required in testing circuits where only a small amount of current is available, an instrument is provided with a sensitivity of 50 microamperes, providing 20,000 ohms per volt on all d.c. voltage ranges.



There is also a complete coverage of decibel ranges from minus 10 to plus 55 for volume indications.

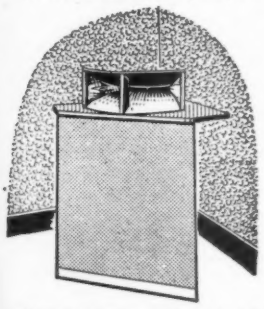
The unit is approximately 34x17x9 inches and weighs 37 lbs. Two compartments for accessories and instructions are located at the base of the cabinet. All connections are made to binding posts located on the panel. Test leads and break-in plug are furnished.—RADIO-CRAFT

SPEAKER SYSTEM

Brociner Electronics Laboratory
New York, N. Y.

The Klipsch speaker system uses a horn for the low frequencies as well as for the high-frequency range.

The low-frequency horn is folded and uses a corner of a room as an integral part of the acoustic system so its performance is equivalent to much larger conventionally designed horns. With both the high- and low-frequency speakers coupled to horns, their relative efficiencies are nearly equal. It is not necessary to attenuate the high-frequency unit to match the low-frequency output. The high-frequency horn



provides a 90-degree horizontal distribution pattern of frequencies above 500 cycles, to match the dispersion of the low-frequency horn. The frequency range of the system is from 30 to 15,000 cycles. The dividing network is a constant-resistance, parallel type, providing 12 decibels per octave attenuation, and has a crossover frequency of 500 cycles. An L-pad permits adjustment of balance to suit individual conditions. Because of the horn loading, even at full power, distortion is of the order of 1/100 to 1/400 of that of direct radiators.

The system is available as a complete unit, or individual components can be obtained separately. Model 1A is rated at 20 watts and other models provide power-handling capability up to 60 watts in one unit.—RADIO-CRAFT

SWEEP CALIBRATOR

Browning Laboratories, Inc.
Winchester, Mass.

The Model GL-22 sweep calibrator is a pulsed timing marker oscillator de-

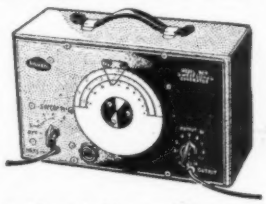
signed for use with standard oscilloscopes and synchroscopes for accurate measurement of time intervals on either triggered or recurrent sweeps. Variable amplitude markers of either polarity are provided for use as intensity markers or directly on the cathode-ray tube plates as deflection markers. Markers available are 0.1, 0.5, 1.0, 10, 100 microseconds. A positive or negative variable-width gate pulse output is provided for test purposes. The pulse duration corresponds to the duration of the marker group. Operation is by external synchronizing triggers or from an internal trigger generator, with output triggers of both polarities available at the front panel.

The unit measures 14x7x7 inches and weighs 20 pounds.—RADIO-CRAFT

SWEEP GENERATOR

McMurdo Silver Co., Inc.
Hartford, Conn.

The new Model 909 sweep generator is designed to permit rapid and simple visual alignment of FM and television

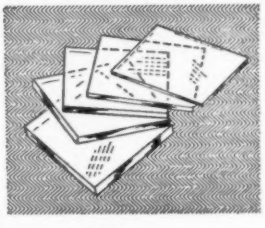


r.f., i.f., and video amplifiers. It covers a center-frequency range of 2 mc through 226 mc in 3 bands. Frequency modulation is adjustable from 40 kc to over 9 mc, and output is adjustable from zero to ½ volt maximum with panel controls. Synchronization of the oscilloscope used to trace visually alignment "pictures" is at power line frequency (or selected multiple or submultiple), or by a 120-cycle, saw-tooth synchronizing voltage available from the generator.—RADIO-CRAFT

POLYSTYRENE WINDOW

American Phenolic Corporation
Chicago, Illinois

A clear polystyrene windowpane for radio applications makes it possible to bring the antenna lead-in into the room without cutting through the window casing or drilling the glass. The glass pane is replaced with the plastic sheet which can be drilled to accommodate feed-through insulators or to



pass wire or co-axial cable. The polystyrene does not discolor under light or absorb water.

These windowpanes are available in all sizes and thicknesses.—RADIO-CRAFT

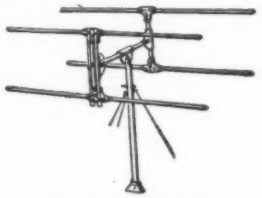
TELEVISION ANTENNA

Camburn, Inc., Woodside, N. Y.

The Double Decker antenna is designed to give a favorable standing-wave ratio over the entire range of television frequencies. The stacked dipoles provide broad band response and high signal strength. Reception is unidirectional at right angles to the antenna.

The array can be rotated and tilted for best signal strength.

This antenna is also available for FM.—RADIO-CRAFT



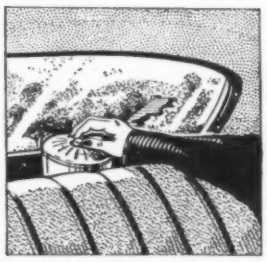
REMOTE SPEAKER

Dapco Products, Inc.
Defiance, Ohio

An auxiliary radio speaker has been designed for easy installation on the package deck behind the rear seat in an auto sedan or coach. It does not require a recess hole to be cut in the shelf, but is held in place with 2 small self-tapping screws.

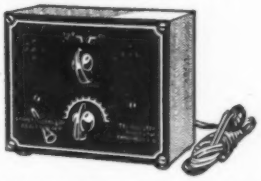
The Re-Mote 5-inch speaker has a sealed, dustproof voice coil and fixed resistors to match all standard car radios, and includes a volume control.

It is housed in a plastic case, with louvres on top for proper acoustical balance and tone quality.—RADIO-CRAFT



TELE-FM PREAMPLIFIER

Vision Research Laboratories
Richmond Hill, N. Y.



This television preamplifier boosts the strength of weak stations to a point where suitable reception is possible. It is entirely self-contained and is connected to the television set by attachment in series with the antenna. A 2-position switch on the front panel is switched on for the preamplifier or off for normal set operation.

The unit is 3x5x6 inches and is furnished in 3 models covering channels 1-6, 7-13, and 88-108 mc.—RADIO-CRAFT

ANTISTATIC POWDER

General Cement Mfg. Co.
Rockford, Illinois

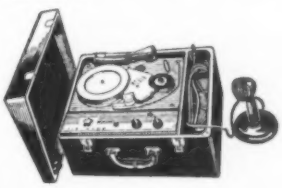
This is a powder which minimizes auto radio static interference due to the accumulation of static electricity on the car. The powder is poured into a powder injector which is screwed onto the fire valve. Air pressure is then used to blow it into the inner tube.—RADIO-CRAFT

PORTABLE RECORDER

Air King Products Co., Inc.
Brooklyn, N. Y.

This recorder embodies a 5-tube (including rectifier) amplifier with radio attachment cord. It plays either 10- or 12-inch records and comes equipped with permanent needle. Recordings from the phonograph or radio can be made directly through the amplifier, and voice also can be dubbed in through the microphone while recording from radio.

The recorder includes an automatic shutoff to turn the motor off after the wire rewinds. A safety lock prevents accidental erasures, and a visual indicator checks recording level.—RADIO-CRAFT



GEIGER COUNTER

Amperex Electronic Corporation
Brooklyn, N. Y.

These Geiger-Mueller counter tubes are physically redesigned for standardized production.

New developments include direct bonds between mica and metal and mica and glass, eliminating many of the difficulties inherent in gasketed or waxed seals.

The first series to be released includes counter tubes for beta, gamma, and X-rays.—RADIO-CRAFT

PICKUP EQUALIZER

Radio-Music Corp.
Port Chester, N. Y.

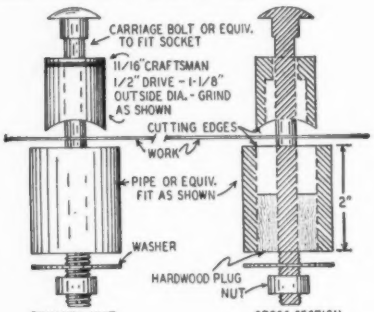
The new EL-3 equalizer has been designed for simplified operation plus good reproduction from both vertical and lateral recordings. The system allows using one arm for vertical only and one arm for lateral only, on one turntable or separate tables, by connecting both arms to the equalizer. Switching the equalizer from vertical equalization to lateral allows changing from one arm to the other . . . at the same time, the correct equalization is thrown in. Both the RMC vertical and lateral reproducers can be replaced by the RMC universal head.—RADIO-CRAFT

TRY THIS ONE

TUBE SOCKET PUNCH

This socket punch is easily made and can cut about 20 holes before it needs resharpening.

To make the cutter, grind a socket from a socket-wrench set to the shape shown in the drawing. The outside diameter of the socket is 1⅛ inches (for a 1⅛-inch hole), but a larger or smaller size may be used if desired.



FINISHED UNIT FIG. 1 — CROSS SECTION FIG. 2

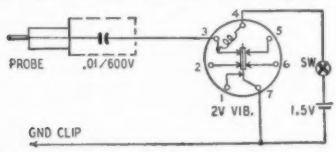
The die for the cutter is made of a piece of thick-wall pipe cut off square. It should fit snugly around cutter but not bind, if the hole is to be a clean one. Force a hardwood cylinder halfway into the pipe and drill it accurately through the center for a snug, sliding fit for the bolt.

Choose the bolt to fit the drive hole of the socket without any play. If the socket has a square drive hole, use a bolt with a square collar that can fit into it.

JOHN KWIETINSKAS,
Duquesne, Pa.

SIGNAL GENERATOR

An excellent signal generator can be constructed from a surplus 2-volt vibrator. It provides a.f. and r.f. signals for trouble-shooting and aligning of receivers. It is compact and easily carried around, and the operating cost is low because it uses only a 1½-volt battery. A volume control can be added to control the output.



JOHN ZVERLOFF,
Akron, Ohio

HANDY TOOLS

Hacksaw blades can be ground into small sharp knives that are useful around the workshop. Facial tissue can be cemented to a piece of broken blade to get into places that a pipe cleaner cannot reach.

ELMER C. CARLSON,
Brooklyn, N. Y.

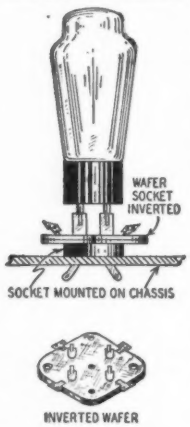
FOR EASY SOLDERING

When it is necessary to solder a lead or component to a chassis and solder with rosin flux will not stick, try using Kester aluminum solder. I have used this a number of years and have not been troubled with corrosion. It will even adhere—but not too well—to that white brittle metal often used for phono tone arms and dial drums.

THOMAS RUMNEY,
Toronto, Canada

TEST-POINT ADAPTER

Test-point adapters may be made cheaply from midget wafer tube sockets. Remove the tube from the set and plug it into an inverted wafer socket. Then plug the whole back into the socket on the chassis. The prongs from the wafer socket project and can be hooked onto easily with pee-wee or crocodile clips. The receiver can, in most cases, be tested without removing it from the cabinet.



JOHN ZVERLOFF
Akron, Ohio

TUBE REMOVER

A sewing-machine screw driver is the basis of this novel tube remover. To make it, hold about ¾ inch of the screw driver blade in a vise and bend it sharply 45 degrees.

Slip the bent end of the screw driver blade between the base of the tube and its socket. A little leverage on the handle will force the tube out easily.

OSCAR E. MALECH,
San Francisco, Calif.

CLEANING SPEAKERS

An easy way to remove iron filings and bits of metal from between the voice coil and field pole of dynamic speakers is to pass alternating current through the field coil. This demagnetizes the core and permits the small bits of metal to be shaken or blown out.

W. HARVEY MERWIN,
Jensen Beach, Florida

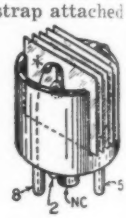
SELENIUM RECTIFIER HOLDER

Here is a new way to install selenium rectifiers in radios designed for vacuum-tube rectifiers. Cut a slot the width of the new unit in a tube base to within 1/16 inch of the bottom. Solder insulated leads to the terminals and fit the entire assembly into the slot. Pull the wires through the prongs in the base and solder them. The wires should be pulled tight to hold the rectifier firmly in place.

After the circuit wiring is changed, plug the new rectifier into the tube socket.

GEORGE J. DASKO,
Oka, Quebec

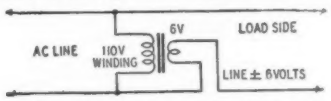
(Another method of installing a selenium rectifier was suggested by R. V. Johnson of Chicago, Illinois. It is to solder a tube prong to each strap attached to the unit. The rectifier is installed by merely plugging it into the tube socket after rewiring the set. Many parallel suggestions have been made by servicemen and experimenters. —*Editor*)



VOLTAGE BOOSTER

Where low line voltage causes poor reception on receivers, a toy or filament transformer can be used to boost the line voltage to close to its normal rating.

The required transformer secondary voltage depends upon the amount of increase desired, and can be varied in many toy transformers. The 2 windings must be connected to add voltages and to prevent bucking—correct connections can be determined with a voltmeter.



GEORGE PURAINEN,
Sudbury, Ontario

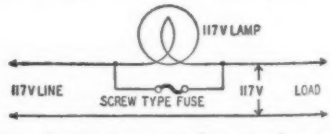
STRIPPING LITZ WIRE

Do you have trouble stripping insulation from Litz wire and the fine wires commonly used on pickups and headphones? If so, try passing a lighted match slowly under the end of the wire. This will char the insulation sufficiently to permit it to be pulled off. Use care so that the fine wires will neither char nor melt.

FRED PEARSALL,
Medford, N. Y.

SHORT INDICATOR

A light bulb connected in parallel with the fuse connected to the service bench is a good short-circuit indicator. If the fuse melts, the lamp will light. The lamp should be a small one, that will not impair the action of the fuse. A 7½-watt bulb is adequate.



JOHN A. FLOR,
Milwaukee, Wis.

BUY *from America's* STOREHOUSE *of* QUALITY PARTS

RADIO SUPPLY & ENGINEERING CO., Inc.

LOWEST PRICES

125 SELDEN AVE. DETROIT 1, MICH.

VOLUME CONTROLS

1000 ohm wire wound midgets — manufacturers close out — ¼" shaft ⅝" long — list $1.25 — over 90% off.

EACH **12c**

SEALED Box of 252 **24.95**

OUTPUT TRANSFORMERS

Clean stocks — long leads — mounting feet — made to fit where you need them.
For 6F6-6K6 — to 4 ohm voice coil — size 2" x 1⅝" x 1⅜".
50L6-35L6-25L6 to 4 ohm voice coil 1⅜" x 1⅝ x 1⅜".
Specify quantity of each type you need at..... **49c**

MULTI-USE WIRE

An old favorite — back again! Stranded No. 22 tinned wire — glass "ROCKBESTOS" 1000 volt insulation—fireproof aircraft wire — a wartime development — at this low price you can use the best.

100 feet..... **45c** 1000 feet..... **3.89**

Pep-Up PHILCO CHANGERS

Here are the two most important items in "Beam of Light" changers—and priced to give you more profit!
Selenium cell only, no holder, post paid..... **1.80**
Special original equipment lamp.... **27c**

8/8/8-450 VOLT CONDENSERS

A nationally advertised triple 8 mfd.—450 volts — inverted screw mounting — insulated aluminum can 1⅛" x 4"—insulated leads 6" long. List price $4.25. One time only at..... **89c**

MIDGET I. F. TRANSFORMERS

Back again — by popular demand! RSE scores again with a new and better I.F.! 400-500 KC range — 1¼" square x 2½" high-ceramic based mica trimmers — high gain iron cores — pep up old receivers — ideal for new construction — and now available in either input or output types — for peak performance! Individually boxed in the colorful RSE carton. List price $2.10. LR1—input; LR2—output; Specify Type.

Each	Matched Pair	Dozen	Egg Crate of 100
36c	**69c**	**3.95**	**29.00**

PANEL METERS

Top quality instruments! All new — not war surplus — boxed — seven popular types — priced right — your chance to get those meters you've always wanted!

Model 332 — 0-150 A.C. volts — 3" round flush mounting black brass case.
Model 221 — 0-30 D.C. volts — 2" round flush mounting bakelite case.
Model 324 — 0-400 D.C. volts — 3" round projection mounting — bakelite case.
Model 331 — 0-30 A.C. amps. — 3" round flush mounting bakelite case.
Model 322 — 0-150 D.C. volts — 3" round flush mounting black brass case.
} **2.95 EACH**

Model 347 — 0-150 MA radio frequency thermocouple — 3" square bakelite case.
Model 341 — 0-500 MA radio frequency thermocouple — 3" round bakelite case.
} **3.95 EACH**

Supply limited — order *now* — list models you desire.

A STAR STUDDED STOCK

And every item a "Star Studded Item"—only standard merchandise by nationally known manufacturers is ever advertised by RSE. Remember our policy — your money back if not 100% satisfied!

PHONO PICKUP CRYSTALS

Standard types — Set Manufacturers close-out — all Guaranteed

P30-W60 — One of the newest and finest — osmium tipped permanent needle — 1.8 volts output — fits standard mounting holes. List price $7.50 you pay us..... **2.69**

P93-W57A — stamped metal case — pin type terminals — ¾ oz. pressure — 1.6 volt output — 5000 cycle cutoff. List price $5.55 — Our special..... **1.98**

L70 — new postwar design — solder terminals — 1¼ oz. pressure — 1 volt output — 4000 cycle cutoff List price $5.55 — we quote you..... **1.98**

L75 — another new type — 1¼ oz. pressure — .75 volt output — 6000 cycle cutoff. List price $5.55 — 64% off..... **1.98**

L40 — the prewar favorite in a **die cast case** — used in millions of phonographs — solder terminals — 1¼ oz. pressure — .6 volt output — 4500 cycle cutoff. List price $4.45 — your cost..... **1.98**

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DEMAND THIS SEAL OF QUALITY

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Include full remittance with orders of $3.00 or less. Include 25% deposit with all C.O.D. orders of $3.00 or more. All shipments sent express collect if postage is not included. Prices subject to change without notice. BE SURE TO INCLUDE SUFFICIENT POSTAGE. EXCESS WILL BE REFUNDED.

.5-300 VOLT CONDENSERS

A name brand manufacturers close-out special — we pass the savings on to you! New fresh stock — size ¾" x 2½" — tinned leads — all guaranteed 60c List — your discount 90%.

Net Each	10 for	100 for
6c	**49c**	**3.95**

VOLUME CONTROLS

Our own private brand — made by a nationally known manufacturer — you have this same control on your shelf now — the same kind that net for $1.09! Standard noise-free carbon construction — ⅜" bushing — ¼" shaft, 2" long — complete with switch. Ideal all purpose replacement control — individually boxed in our colorful carton carrying the RSE quality seal of approval.

Full range of sizes — with attached switches!

10 M ohms
15 M ohms
25 M ohms
50 M ohms
100 M ohms
250 M ohms
500 M ohms
1 Meg ohms
2 Meg ohms
500 M Knurled Shaft

59c each
55.00 per 100 assorted

500 M ohms less switch, 39c ea. 100 for $35.00

CIRCO MODEL 451A AC-DC Volt-Ohm-Meter

A dependable instrument of wide utility — sensitivity 1000 ohms per volt.
Ranges: Volts AC, DC, and Output Ranges: 0-10/50/100/500/1000. Ohms full scale, 500,000. Ohms center scale, 7200.

TEST LEADS .59

NET complete with batteries..... **14.90**

CIRCO MODEL 312 Volt-Ohm-Milliammeter

An economy pocket meter featuring a 2" moving vane meter.
Reads: AC-DC volts, 0-25/50/125/250; Mills AC-DC, 0-50; Ohms, 100,000; mfd. .05-15.
Jacks provide range selection

TEST LEADS .. .59

NET Complete with cord and plug.... **6.75**

OZ4 TUBES

New, guaranteed, made by the only maker of OZ4's. Buy now! Hit that car radio business hard — $2.20 List — 60% or more off — limited quantity

In colorful RSE box **88c**

Egg crate of 100 **.$79.**

PAPER BY-PASS CONDENSERS

Name brand condensers made by a prominent eastern manufacturer! Regular nationally advertised jobber-serviceman line! New, fresh, full capacity standard merchandise — not surplus — all guaranteed! Check the list prices — our low nets — no need to figure the discount — buy 'em now, they've hit bottom!

Mfd.	Volts	List Price	Net Each	Per 100
.01	600	30c	10c	$ 9.15
.02	600	30c	11c	$ 9.95
.05	600	40c	14c	$12.95
.1	600	45c	16c	$14.95

Quantity Prices not assorted.

RADIOMEN'S HEADQUARTERS — WORLD WIDE MAIL ORDER SERVICE!!!

BUFRAD CAR RADIO ANTENNAS

All of our car radio antennas are made of triple plated Admiralty Brass Tubing, complete with low loss shielded antenna leads and high quality fittings.

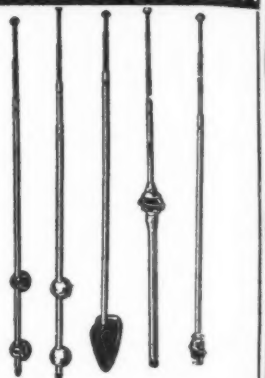
SIDE COWL—BR-1, 3 sections extend to 66". Your price—single units—**$1.50**; in lots of 12—**$1.35** ea.

SKYSCRAPER—BR-2 has 4 heavy duty sections that extend to 98". Your price—single units—**$2.45**; in lots of 12—**$2.25** ea.

TILT ANGLE—BR-3, may be adjusted to all body contours. 3 sections extend to 66". Single unit price—**$1.50**; 12 lot price—**$1.25** ea.

VERSATILE—BR-4, single hole fender or top cowl mounting may be adjusted to conform with all body contours. 4 sections extend to 56". Single unit price—**$2.90**; 12 lot price—**$2.75** ea.

THE MONARCH—BR-5, single hole top cowl mounting, 3 sections extend to 56". Single unit price—**$1.90**; 12 lot price—**$1.75** ea.



BR1 BR2 BR3 BR4 BR5

BENDIX SCR 522—Very high Frequency Voice Transmitter-Receiver—100 to 156 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00. Crystal Controlled and Amplitude Modulated—HIGH TRANSMITTER OUTPUT and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles high altitudes. Receiver has ten tubes and transmitter has seven tubes, including two 832's. Furnished complete with 17 tubes, remote control unit, 4 crystals, and the special wide band VHF antenna that was designed for this set. These sets have been removed from unused aircraft and are guaranteed to be in perfect condition. We include free parts and diagrams for the conversion to "continuously variable frequency coverage" in the receiver.

The SCR 522 complete with 24 volt dynamotor sells for only **$37.95**. The SCR 522 is also available with a brand new 12 volt dynamotor for only **$42.95**.

SPEAKERS—These PM speakers are the finest that are available. All have heavy duty size Alnico V magnets.

3½"	$1.15	6 for	$6.60
4"	$1.15	6 for	$6.60
5"	$1.10	10 for	$9.50
6"	$1.50	6 for	$8.70
7" (Car Radio Size)	$4.50	6 for	$21.50
8" 10 oz.	$3.95	6 for	$20.50
8" 21 oz.	$4.95	6 for	$26.50
10" 21 oz.	$5.50	6 for	$30.00
12" 21 oz.	$7.95	6 for	$42.00

AUTO RADIO DEALERS! ATTENTION!

Nationally advertised brand of 1948 car radio which will fit practically any car and every pocketbook. Six tube superheterodyne with three gang condenser and 6½" speaker. **$32.20 for sample, or Dealer price $29.97 each, in lots of two or more.**

Here is an item that no serviceman who repairs auto radios should be without. Nationally advertised ATR battery eliminator that supplies perfectly filtered 12 VDC or 6 VDC at 14 amp from 110 VAC **$36.00**

RADIO SERVICEMEN!! Buffalo Radio Supply's lower prices mean increased profits for you. Order all of your needs from us and receive in return courteous service and first class merchandise at the lowest prices in the country.

TUBES—All types in stock, **60% off** on all tubes if ordered in lots of 10 or more.

TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS;** Steps up 110v, or steps down 220v to 110v—**$1.95.**

FIL. TRANS.: 6.3v, 20 Amps.—**$1.98**; Universal Output Trans- 8 Watt—**89c**; 18 Watt—**$1.29**; 30 Watt—**$1.69. AUDIO TRANSFORMERS:** S. Plate to S. Grid, 3:1—**79c**; S. Plate to P.P. Grids—**79c**; Heavy Duty Class AB or, B. P.P. inputs—**$1.49**; Midget Output for AC-DC sets—**69c**; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—**$2.00** Stancor SB or DB mike to line or grid—**$1.95.**

POWER TRANSFORMERS—Half-shell type, 110V, 60 cy, Centertapped HV winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V, 40MA, 5V & 2.5 or 6.3V.....**$1.49**
For 5-6 tube sets—650V, 45MA, 5V & 2.5 or 6.3V..... **1.75**
For 6-7 tube sets—675V, 50MA, 5V & 2.5 or 6.3V..... **1.90**
For 7-8 tube sets—700V, 70MA, 5V & 6.3 or two 2.5V.....**2.35**
For 7-8 tube sets—700V, 70MA, 5V & 6.3 (25 Cycle)..... **3.60**
For 8-9 tube sets—700V-90MA, 5V-3A, 2.5V-3.5A, 2.5-10.5A **2.85**
For 9-11 tube sets—700V, 5V & 6.3V-4A..... **2.85**
For 9-15 tube sets—600V, 150MA, 5V & 6.3V..... **2.95**

CONDENSERS—PAPER TUBULAR 600 WV—.001, .002, .005—8c; .01, .05—9c; .1—10c; .25—23c; .5—35c; **ELECTROLYTICS:** 8mfd 200v—20c; 16mfd 35v—20c; 30mfd 150v—23c; 20/20mfd 150v—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 16mfd 350v—65c; **OIL CONDENSERS:** 4mfd 600v 49c; 2mfd 600v—29c; 3X.1mfd 600v—29c.

FILTER CHOKES: 200, 300, 400, 500 ohm light duty—59c; 200 or 300 ohm heavy duty—99c; 250 ma 35 ohm, made for U.S. Navy, fully shielded—**$1.95**; 75 ohm 125 ma—25c or 25 for **$4.25**; "Meissner type" tapped filter chokes—25c; 8 amp. iron core A filter—25c; Choke-condenser combination, ideal to replace any size speaker field when installing PM speaker—79c.

110V. CIRCUIT BREAKERS of Magnetic type: Following Current Ratings in Stock: 1.25, 3, 4, 8 Amps. Please specify. **$1.95 each.**

SEVEN ASSORTED I.F. TRANSFORMERS—$1.98; Five Asstd. Oscillator Coils—69c.

SELENIUM RECTIFIERS—Dry disc type 1½", 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—**90c.**

METER RECTIFIER—Full wave, may be used for replacement, or in construction of all types of test equipment—**$1.25.** Half Wave—90c.

FREE ! ! ! ! THIS MONTH ONLY
A HIGH GRADE CRYSTAL PICK-UP WITH THE PURCHASE OF EACH PHONO MOTOR AT $4.95.

CLOSING OUT

THE FOLLOWING DESIRABLE ITEMS AT SACRIFICE PRICES TO MAKE ROOM IN OUR WAREHOUSE FOR INCOMING STOCK

5" "SO" RADAR P.P.I. SCOPE, complete with 9 tubes including 807 tube in final power stage that provides deflecting current for magnetic yokes. Selsyn motor and self-contained 110 V. power supply designed to run on the AC supply on LST and PT boats. Various ranges from 2 to 80 miles. The most satisfactory scope available for navigational radar or panoramic television applications.—Nationally advertised as surplus at $100.00. Our price, only **$39.95.**

947A ONE KILOWATT HIGH FREQUENCY TRANSMITTER. This relay controlled transmitter includes a 115V, 60 cycle power supply, protected by 3 magnetic circuit breakers, that alone is worth more than the price we are asking for the whole rig, even on today's surplus market. On the front panel are six 3½" GE or Weston meters, including 250 MA, 50 MA, 1000 MA, 150 V AC and 1500 V DC at 1000 ohms per volt for screens and plate. The rack-type 21" x 15"x 36" unit contains six amplifier and rectifier tubes aggregating over $60.00 at WAA current wholesale prices. Western Electric's price to the government was $1500.00. Shipping weight 400 lbs. Your cost at closeout price as is, Formerly $69.95, now only **$39.95**

LORAN INDICATOR OSCILLOSCOPE complete with 26 tubes and a 5" cathode ray tube. Greatly superior to other scopes because the multivibrator circuit incorporated can be used to present two traces simultaneously on screen. Thus input and output of an amplifier stage can be viewed at same time on screen. Distortion is indicated conclusively by difference between input and output traces, while fidelity is made evident by identical traces. Government instruction manual included. **$39.95**

MICROPHONES—All nationally known brands. Bullet crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—**69c**; Handy Mike—**90c**; Lapel Mike—**93c**; SHURE T-17 MIKES, with push to talk switch—**99c.**

20 ASST'D COIL FORMS, including 11 ceramic, 8 polystyrene, and 6 fiber, all useful sizes—**50c.**

VARIABLE CONDENSERS: 350 MMFD, 5 gang—**$1.95**; 4 gang—**$1.49**; 3 gang—**83c**; 7.5 to 20 MMFD, 1750v spacing, extra long shaft Hammarlund—**69c**; miniature variables, 25 MMFD—**39c**; 50 MMFD—**49c**; 75 MMFD—**59c**; 100 MMFD—**69c**; 140 MMFD—**79c.**

INTERRUPTION FREQUENCY COILS for super-regenerative receivers or the tremendously popular FM adapters for standard broadcast sets. Iron core with a resonant frequency of 50 KC—**39c**; Air Core, 100 KC—**29c.**

30 MC IF TRANSFORMERS, double slug tuned—**25c.**

30 MC VIDEO AMPLIFIER PLATE COILS—Slug tuned—**25c.**

REMOTE CONTROL UNIT: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—**59c.**

MODULATION TRANSFORMERS—10 watt, metal case **98c**; 30 watt, open-type, **$1.95**; 40 watt, cast aluminum case, **$2.95**; Class "B" input transformers, cast aluminum case, **$1.95**; Transceiver audio transformers, **65c**; Transceiver modulation transformers, **65c.**

MINIATURE PLIERS SET contains one of each of the following: Needle nose, flat nose, parrot nose, standard nose. All contained in a leatherette case. Your cost—**$1.98.**

SOCKET WRENCH SET consisting of 5 sockets ranging in size from 5/16 to ½" and a handle—**79c.**

AUTOMATIC WIRE STRIPPERS will strip up to 1000 wires per hour, a handy tool for any service job—**$3.52.**

FLUORESCENT LIGHT BALLASTS. Single 30 or 40 watt,**$1.68**; Dual 40 watt High Power Factor—**$3.75.**

HEADPHONES—Highest quality Signal Corps headsets with 12" cord and plug **$1.25.** 5' rubber covered patchcords with phone plug and socket—**45c.**

LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for **98c.**

RT-1579 consists of a three stage cascade 6SJ7's and 6F6 output stage high gain, high fidelity amplifier with 60 cycle, 110V power supply on the same 13½x14½ chassis, which is protected by a substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as a husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each, from the special input and output filters, will result in as high a fidelity amplifier as can be obtained. Your cost with tubes, diagram and parts list included—**$14.95.**

We also offer the **RT-1579** with a Raytheon Magnetic Voltage Regulator already installed beneath the cover. Imagine an amplifier complete with tubes, built to Western Electric quality standards, and immune to line voltage variations besides, making it perfectly suited for the most difficult industrial, circus, carnival or commercial installations, offered for a total price of only **$19.95**, our price for both units.

AT LAST YOU CAN AFFORD A LABORATORY STANDARD MICRO VOLTER

The famous Measurements Corp. Model 78B, 5 Tube Laboratory Standard Signal Generator (that sold new FOB Boonton, N. J., for $310.00 net) is available in perfect condition for 25 to 60 cycle, 115 V AC operation. Until now this is the sort of topflight lab equipment that discriminating buyers have only vainly hoped would be released at a bargain price. Worth every cent the manufacturer asks, but available FOB Buffalo while our limited supply lasts for only $79.95.

Such companies as Admiral Corp. and John Meck, Inc., have ordered from us and repeated many times on these 78 generators for use in their labs and production line testing.

Model 78-B Standard Signal Generator. Two Frequency Bands between 15 and 250 megacycles.

"REMEMBER THAT A STANDARD IS ONLY AS RELIABLE AS ITS MAKER."

TAKES ALL THREE BIG BARGAINS

$9.95

1. AUDIO AMPLIFIER Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles. 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 20 lbs. **SUPER SPECIAL—$4.95** while supply lasts.

2. RADIO HEADSETS Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. $.59 per pair **OR 3 PAIRS FOR $1.00.**

3. HOME WORKSHOP AT BARGAIN PRICE

Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

NO C. O. D.'s—ORDER NOW—DON'T DELAY

Cable Address: BUFRAD

Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 4 C. BUFFALO 3, N. Y.

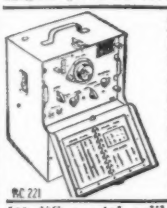
RADIOMEN'S HEADQUARTERS — WORLD WIDE MAIL ORDER SERVICE!!!

DUE TO POPULAR DEMAND WE REPEAT THESE TERRIFIC BARGAINS

Three assorted new **MICROPHONES**, including push-to-talk type $1.49
Ten assorted **R. F. Chokes** including high frequency types ..... $ .35
Five assorted **AUDIO or FILTER CHOKES** ..... $ .99
One Hundred assorted **RESISTORS** $1.95
Ten assorted **JAN CABLE CONNECTORS**, including SCR274,522 and BC375 types ..... $ .99
Six assorted **OIL FILLED CAN TYPE CONDENSERS**, all with mounting brackets $1.49
Ten assorted **METAL & BAKELITE KNOBS**—(no wooden knobs) ..... $ .39
Six assorted **VARIABLE CONDENSERS**, including butterfly types $1.49
Six assorted **POWER and AUDIO TRANSFORMERS**, all new $1.98
Six assorted isolantite and bakelite **R. F. COILS**, shielded and unshielded ..... $ .99

The above ten assortments totaling over $12.00 at the unbelievable bargain prices listed can be purchased together as one lot at a super-special total price of only $10.00. All merchandise guaranteed to be as advertised.

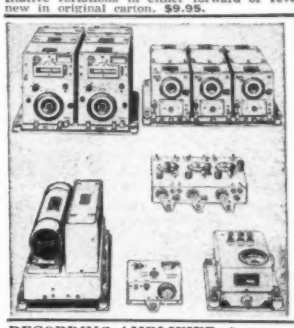
Aluminum gear box 18x8x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar usage $3.00
BRAND NEW 110 V AC INPUT POWER SUPPLY, in grey enameled shock-mounted case 9" x 10" x 16". Several heavy duty resistors, 3 chokes, 4-1000 V and 600 V oil-filled condensers, 1 relay, 2-5U4's, 3 voltage regulator tubes, safety interlock, and several fuses are included in this regulated power supply at the bargain price of $9.95


BC 221

BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **$36.95.**

100 KC crystal calibrator kit containing everything that is necessary to construct a 100 KC osc. that will supply 100 KC marker points to your receiver so that it may be used for frequency determination. The 100 KC crystal is worth far more than the price that we are asking for the complete kit.
Kit 100K Plate and fil voltage supplied by receiver $9.95
Kit 100KA Same as above, including 110 VAC or DC self-contained power supply $12.95

RT1463 7 tube amplifiers containing 3-7F7, 1-7Y4, 3-7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required for ailerons, rudder and elevator, in the original application. A control amplifier of the ordinary type would deflect the rudder by some arbitrary amount when the ship was blown off the course to port or starboard. The result would either be that the correction was insufficient and the plane continued off course, or the correction would be too great, starting a series of tackings and would greatly increase fuel consumption and elapsed time in reaching the objective. This phenomenal unit, with its 3 amplifiers and six 5000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black crackle aluminum case. Brand new in original carton. **$9.95.**

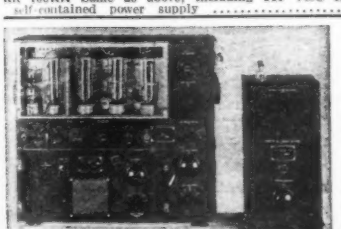


SCR-274N COMMAND SET

The greatest radio equipment value in history

A mountain of valuable equipment that includes 3 receivers covering 190 to 550 KC; 5 to 6 MC; and 6 to 9.1 MC. These receivers use plug-in coils, and consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28 V. Dynamotors (easily converted to 110 V. operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at **$29.95,** including crank type tuning knobs for receivers. Without these knobs the receivers can't be tuned, and are only useful for parts. Don't buy without knobs!

RECORDING AMPLIFIER. 3 stage, 110 V, 25 or 60 cycle high gain amplifier built by recently bankrupt manufacturer specifically for recording use. Transformer for low impedance wire recorder head or magnetic cutter included on chassis. Tone and volume controls and switches on chassis for playback, recording or use as public address amplifier. Complete with tubes $9.95



GENERAL ELECTRIC 150 WATT TRANSMITTER

Cost the Government $1800.00
Cost to you $44.50!!!!

This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: **FREQUENCY RANGE:** 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification). **OSCILLATOR:** Self-excited, thermo compensated, and band calibrated. **POWER AMPLIFIER:** Neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. **MODULATOR:** Class "B"—uses two 211 tubes. **POWER SUPPLY:** Supplied complete with dynamotor which furnishes 1000V at 350 MA. Complete instructions are furnished to operate set from 110V AC. **SIZE:** 21½x23x9¼ inches. Total shipping weight 200 lbs., complete with all tubes, dynamotor power supply, five tuning units, antenna tuning unit and the essential plugs. These units have been removed from unused aircraft but are guaranteed to be in perfect condition.

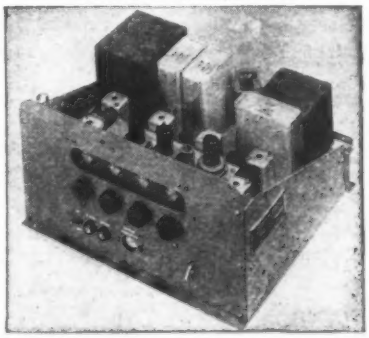
BRAND NEW INVERTERS AND DYNAMOTORS

PE 6A: A 24 to 32 V DC input, to 80 V. AC regulated output converter $12.95
PE 19A: A 24 to 28 V DC input, to 80 V AC at 800 cps output $9.95
(We include a stepup transformer with each of the above so that 110 V AC is available from either.)
27 V DC input 285 V DC @ 75 MA output ..... .98c
27 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp. $5.95
12 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp. $12.00
13 or 26 V DC input. Output 800 V DC, 400 V DC @ 135 MA, and 9 V AC $15.00
(By running on 6 V AC, 60 cycle input, with a small amount of DC for field excitation, the above dynamotor will provide a good source of 12, 24, 400 or 800 V DC.)

GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's, with 4 stag-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, as on 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only **$29.95** or two for **$53.90.** If desired for marine or mobile use, the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

14-TUBE UHF SUPERHET RECEIVER—$39.95



This beautifully constructed receiver was designed especially for Signal Corps communication service, and is one of the finest and most sensitive sets ever manufactured. Operating from 110V 60 cycles, this set has two tuned RF stages, tuned converter and oscillator, *five I.F.* stages, using iron-core I.F.'s, a diode detector, tuning eye, and a two stage amplifier that will drive a speaker or phones. The frequency range is 158-210 Mcs. It is a simple matter to operate on other bands by making a slight alteration in the tuning coils. A complete set of tubes is included with each receiver, along with a circuit diagram and parts list. The high-voltage power supply delivers 150 milliamperes, and is well filtered by a heavy-duty choke and three 7 Mfd. oil-filled condensers. This buy of a lifetime cost the government about $700. Amateurs and experimenters will never again be able to purchase fine equipment at such a tremendous saving! See January *Radio-Craft*, Page 57, for complete conversion to television receiver.

SCR-284 TRANSMITTER-RECEIVER — This medium power transmitter and the accompanying 7-tube very sensitive receiver are naturals for 80 or 40 meter operation (phone or CW), on either fixed stations or mobile applications. These units are brand new and come complete with 17 tubes, key, microphone, 200 KC calibrating crystal and instructions and diagrams for use with up to 100 watts input to the final stage on 40 or 80 meters for either phone or CW, using vehicle or 110 Volt power supply. Your cost $39.95
Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

PE-109 32-Volt DIRECT CURRENT POWER PLANT

This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. **The price of this power plant is only $58.95.** We can also supply a converter that will supply 110v AC from the above unit or from any 16-32V DC source for **$12.95.**

Cable Address: BUFRAD

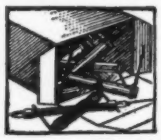
BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 4C. BUFFALO 3, N. Y.

SUPER BUYS

for the HAM & EXPERIMENTER

Save your steps, chum—you can't beat these values anywhere. Come in or write in, but get your order in fast while they last.

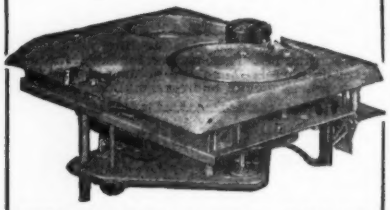
KIT OF 100 IRC RESISTORS



Standard types; ½, 1, and 2 watts. Insulated, metallized and coded. Tolerances of 5, 10 and 20%.

No. KPS496 your cost only $1.95

WEBSTER-CHICAGO WIRE RECORDER FOUNDATION UNIT



MODEL 79 Reduced to $44.10

Now—make your own professional wire recorder at a sensational saving. It's identical to the model used in The Webster Portable Wire Recorder.

It has a complete wire transporting mechanism, tripie-purpose recording head, oscillator coil, 15-minute spool of recording wire plus an instruction sheet with circuit diagram. You can employ any standard Armour type recording spool and make recordings up to a full hour. 10½" x 8¾" x 5½" (3½" below main plate; 2" above). Net wt.: 10 lbs.
Model No. KPS698

Lafayette Radio
Radio Wire Television, Inc.

100 Sixth Avenue, New York 13, N. Y.

542 E. Fordham Rd., Bronx 58, N. Y. | 110 Federal St., Boston 10, Mass.
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ORDER NOW -- MAIL COUPON

LAFAYETTE RADIO, Dept. JD-8
100 Sixth Ave., New York 13, N. Y.

( ) Send No. KPS496 @ $1.95 ea. Quantity ( )
( ) Send Model 79 @ $44.10 ea. Quantity ( )
Enclosed: ( ) Money Order ( ) Check
( ) Rush your newest flyer C-41

Name .....
Address .....
City ..... Zone ... State .....

New Radio-Electronic Patents

By I. QUEEN

LOCATION OF TRANSMISSION LINE FAULTS

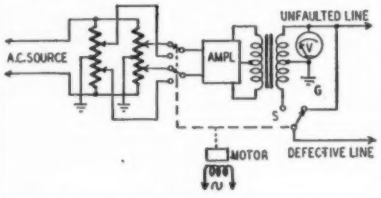
Dale H. Nelson, Southampton, N. Y., and James R. Cosby, Towson, Md.
(assigned to Western Union Tel. Co.)
Patent No. 2,425,554

Several methods have been available for the approximate location of a transmission line fault, such as a short-circuit or an open. A bridge or similar device may be used to calculate the approximate position. If the insulation remains unbroken, however, the exact location cannot be definitely determined.

If the defective conductor runs parallel and close to another conductor known to be good, the following method will determine the exact location of a fault. Audio power, for example at 1000 cycles, is applied in opposite phase to the lines. This may be done by connecting each line at opposite ends of a transformer secondary, with the center terminal grounded.

A linesman with portable detecting apparatus near the lines will pick up the fields radiated by them. So long as there is no defect in either conductor the radiation from either of them is cancelled by the other. A pair of headphones or a meter indicates no signal. As the linesman passes the point of defect this cancellation no longer occurs, and a loud signal will be heard.

In some cases the two lines may not have the same impedance per length, and in addition the



secondary winding of the transformer may not be exactly center-tapped. This produces some signal even without a line fault. The schematic shows a modified form of the invention which eliminates this difficulty and produces an abrupt change at a fault. Three ganged switches are operated by a motor M so that they periodically change from one circuit to another. When the switch S is in the upper position (as shown) it connects the faulted line to the same transformer terminal as the unfaulted line. In the lower position the faulted line is connected to the opposite end of the winding. The input potentiometers are adjusted for correct voltage at V (about 50 volts) at each position of the switches and for equal input voltage either side of ground. The adjustment is necessary because the impedance of both lines together will differ from the impedance of only one line.

To detect a faulted point the linesman adjusts the potentiometers and as the motor operates there will be alternate periods of no signal and a loud signal so long as no fault exists. As the linesman passes a line defect there is an abrupt and very noticeable change in the signal character because no cancellation exists. Only a continuous signal is then heard.

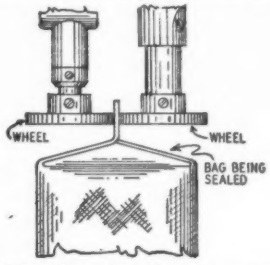
ELECTRONIC SEWING

Benjamin W. Merz, Narberth, Pa. and Albert M. Schweda, Chicago, Ill.
(assigned to Union Special Machine Co.)
Patent No. 2,434,330

This instrument is designed to seal or "sew" electronically. Either one or both parts to be bonded may be a thermoplastic although this is not necessary.

A variable-speed motor controls 2 rotatable shafts, to each of which is fixed a wheel. Each shaft (and wheel) is insulated from the other, and each is supplied with r.f. power from a transmission line. Preferably, each line including shaft and wheel is a quarter-wave in length so that a potential loop exists at each wheel.

The material to be bonded may be in the shape of a bag or package. This bag is placed between the wheels which rotate in opposite directions, so that the bag is moved along between them. The r.f. energy produces heat between the wheels and causes the thermoplastic material to become



sticky. When the material is not thermoplastic, it is necessary to add a strip of film of thermoplastic substance between the sides of the bag. Again heat causes it to become sticky sealing the bag.

The wheels and shafts should be of good heat-conducting material, otherwise the work (such as a bag) may overheat.

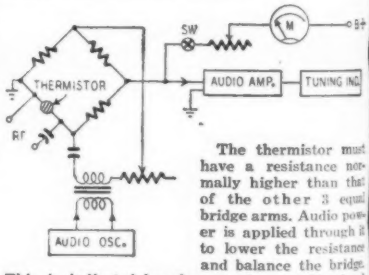
POWER MEASUREMENT

George N. Kamm, Boston, Mass.
(assigned to United States of America, as represented by the Secretary of War)
Patent No. 2,432,199

For several years thermistors have found important use in power measurement. Because of their tiny size and high sensitivity to changes in heat, they can be used at very high frequencies to measure power in the order of microwatts where other methods are strictly limited.

As ordinarily used, the r.f. power heats the thermistor and lowers its resistance. If the element is removed from the r.f. circuit and measured on a bridge, the new resistance value will indicate the power dissipated in it. Special care must be taken since the bridge current itself may heat the thermistor.

In this new circuit the problem is much simplified. Since the thermistor forms part of a bridge during power measurement, the instrument becomes direct-reading and indicates continuously after a preliminary calibration.



The thermistor must have a resistance normally higher than that of the other 3 equal bridge arms. Audio power is applied through it to lower the resistance and balance the bridge. This is indicated by absence of an audio signal through the amplifier. Then the d.c. switch SW is closed and current is adjusted for

$$I = 2\sqrt{\frac{W}{R}}$$

through M. In this equation R is the resistance of the thermistor at balance and W, the power being dissipated in the thermistor, is also equal to the full-scale reading of the tuning indicator. With this current flowing through the bridge the amplifier gain is adjusted for full-scale reading on the indicator which may be calibrated in watts.

The instrument is now calibrated for power readings. The d.c. switch is opened, and the r.f. is applied to the thermistor through an isolating condenser. The calibration may be checked at intervals to eliminate errors due to changes in ambient temperature.

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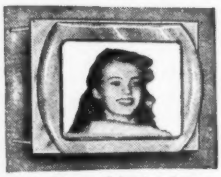

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'Scope Checks Car Radios

By WALTON N. HERSHFIELD

WHEN servicing car radios, time is often a very important factor, particularly when an irate tourist or a traveling salesman simply must have that radio repaired immediately. Several short cuts will speed up work when the serviceman is pressed for time.

The oscilloscope is now becoming an everyday item in the modern service shop. Its application to car radio servicing merely requires a certain amount of know-how.

Excluding tube failure, most car radio trouble is found in the power supply

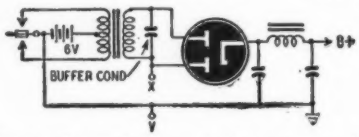

Fig. 1—Nonsynchronous vibrator power supply.

system. Because of the rugged construction necessary for car radios, considerable time is often required to open the radio, inspect the power supply, and diagnose the trouble. The power supply is often shielded, and to inspect it requires still more labor time. If the rectifier tube or vibrator can be removed from the socket, it is possible to check the power

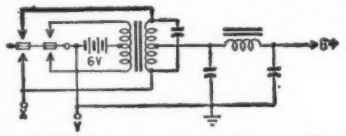

Fig. 2—The less common synchronous vibrator.

supply without opening the set further. Wrap a wire around either plate pin of the rectifier tube or in the case of a synchronous vibrator, connect the wire to one of the secondary pins of the vibrator. Take care to prevent the wire from shorting to ground, or serious damage to either the vibrator or transformer may result. Once the wire is in place merely connect the vertical plates of the 'scope between this point and ground.

For general reference, the circuit in Fig. 1 is a nonsynchronous power supply and Fig. 2 a synchronous one. The 'scope is connected between points X and Y on both circuits.

Wave forms tell the story

Turn on the set and study the waveform from the rectifier or vibrator on the 'scope.

Fig. 3 shows an ideal vibrator wave shape. The distance a-b represents the duration of point contact; b-c represents the time required for the vibrator reed to swing and contact the other point for time interval c-d; b-c also represents the amount of voltage change taking place in the vibrator transformer. Keep in mind that the horizontal axis represents time and the vertical axis voltage.

Fig. 3

Fig. 4

In Fig. 4 we see a ragged line for the point contact periods a-b and c-d. This means that the vibrator points are worn or pitted, and replacement is necessary.

The small notch at a and c in Fig. 5 shows insufficient buffer capacitance. If the buffer is open, the wave shape becomes like the dotted line, and the peak voltages become excessive. The vibrator points are rapidly ruined due to arcing caused by the absence of buffer capacitance to absorb the voltage surges when the vibrator points open.

In Fig. 6 excessive buffer capacitance is indicated by the lack of sharpness at points b and c. This indicates that the value of the buffer condenser is too large. A shorted buffer condenser causes the fuse in the radio to burn out; or if the fuse does not open, excessive current is drawn through the vibrator, the points become red hot and eventually fuse together. If a wave shape similar to that of the dotted line is observed on the 'scope, this is what has happened.

Sells new vibrators, too

Since most vibrators have a vibration frequency of 120 cycles, a new vibrator can be checked and the horizontal sweep settings of the 'scope noted. After this

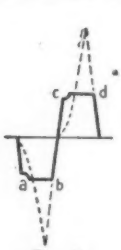

Fig. 5

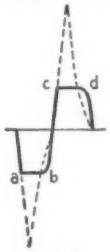

Fig. 6

setting frequency changes from normal due to metal fatigue and loss of temper in the vibrating reed, are easily seen. Use only one complete cycle of the vibrator for comparison on the 'scope screen.

It is apparent that in many cases a vibrator with worn contacts or a leaky buffer condenser, can be found and replaced while the radio is in the shop for other repairs. This will help maintain the shop reputation for "keeping them fixed." The hum of the vibrator tells very little except in extreme cases. From the standpoint of sales it is often a good policy to invite the customer to the service bench to see the condition of his vibrator. For comparison plug a new vibrator into the socket to show the new and improved wave shape. The 'scope does the selling.

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★ R.F. is obtainable separately or modulated by the Audio Frequency.

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★ Simple to Operate—Clips directly on to receiver chassis, no tuning controls.
★ Provision is made for insertion of phones of any impedance, a standard Volt-Ohm Milliammeter or Oscilloscope.

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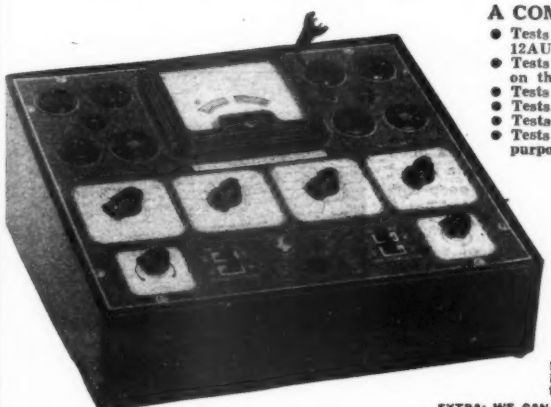

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1V	45	39	7Y4	44	35
1L4	55	49	7X7	44	35
1T4	69	55	7AF7	44	35
1S5	69	55	12A6	35	25
2A5	65	55	12A8GT	45	37
2A6	79	69	12AT6	50	45
2X2	79	72	12BA6	50	45
3A4	69	59	12BE6	50	45
3S4	69	59	12J5GT	49	39
5U4G	50	40	12J7GT	45	39
5W4GT	40	36	12K7GT	45	39
5Y3GT	40	33	12K8	65	59
5Y3G	42	37	12Q7GT	45	39
5Y4G	40	37	12SA7GT	40	32
5Z4G	40	37	12SF7	39	34
6A7	50	45	12SQ7GT	40	32
6A8GT	49	39	12SK7GT	45	35
6AC5	98	92	12SR7	39	34
6AC7	65	60	12SJ7GT	55	49
6AK5	74	69	14A7	65	55
6AG7/6AK7	89	79	14B6	59	49
6B7G	55	49	24A	49	39
6C4	29	25	43	54	49
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6U7G	35	25	35Y4	43	40
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6X5GT	49	39	35Z5GT	43	39
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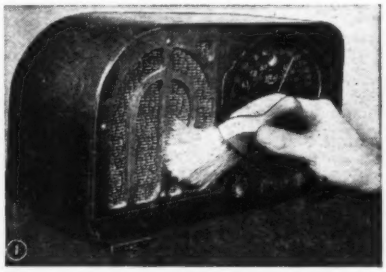
Renew That Cabinet!

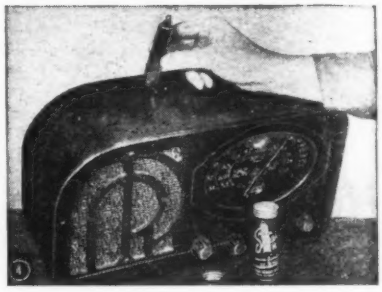
BY HARRY LEEPER

WHILE your customer is unable in most cases to see replacements made in repair jobs, he or she will be quick to note improvements made on the radio cabinet.

Such improvement tends to instill a pride of ownership in the customer as well as confidence in your ability and in the repairs hidden under the chassis.

Appearance of the radio cabinet usually may be brightened and scratches stained by using a few inexpensive tools as illustrated below.





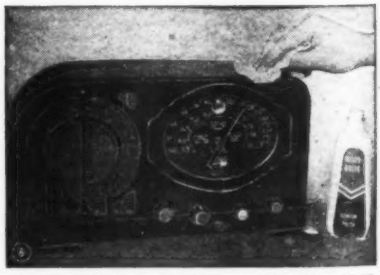


Photo 1. Dust from the speaker grille cloth and around the edges of the cabinet wood is quickly removed with a small brush picked up at the dime store.

Photo 2. Cleaning of glass dial faces is speeded up and done efficiently with liquid window cleaner used in a sprayer. The inside of the glass also should be cleaned while the chassis is out of the cabinet.

Photo 3. Stains and marks from various substances contacting the cabinet can usually be removed with light brushings of carbon tetrachloride.

Photo 4. Shallow scratches are easily treated with a *Skratch Stik* made by General Cement Co. The bare spot is first stained with the crayon end of the stick.

Photo 5. The stick is reversed and the oiled brush end is used. This works well with walnut and mahogany finishes. However, deep cuts may require application of regular liquid stain with a small brush.

Photo 6. The last step is the use of a good furniture polish over all the cabinet. A cloth should be carried in the tool kit and final polish given the cabinet after it is replaced in the customer's home.

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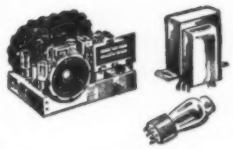

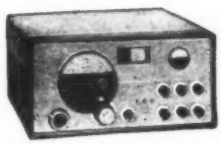

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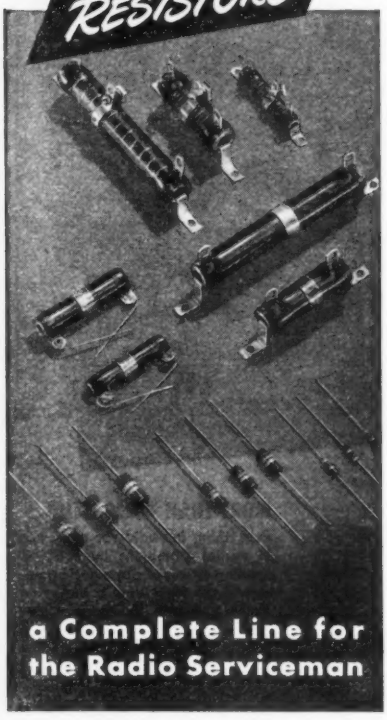

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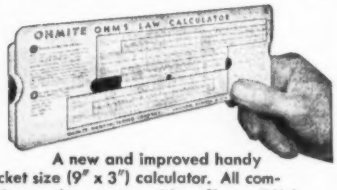

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Six New Tubes

RCA has announced six new Tubes. Three of them, the "Special Red" 5691, 5692, and 5693—specifically designed for industrial and commercial applications requiring tube features of at least 10,000 hours life, exceptional uniformity and stability of characteristics, and rigidity to resist shock and vibration. The unique structural design of these tubes make them capable of withstanding impact shocks of 100g for extended periods.

The 5691, 5692, and 5693 are recommended in general as replacements for the 6SL7-GT, 6SN7-GT, and 6SJ7, respectively, in equipment where long life, rigid construction, extreme uniformity, and exceptional stability are needed, and where the operating conditions are within their ratings. Except for slight differences in characteristics, they are identical with their standard receiving-tube counterparts.

The "Special Red" Tubes are distinctive in appearance—the glass-octal types 5691 and 5692 have red bases and the metal type 5693 has both a red base and a red envelope.

The other three are beam power tubes of the miniature type. They are the 6AS5, 35C5, and 50C5.

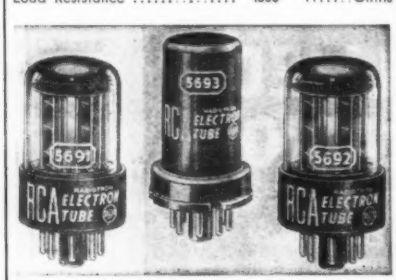
The 6AS5 is intended for use in the output stage of automobile and a.c.-operated receivers. It is capable of delivering 2.2 watts at the relatively low plate and screen voltages.

The 35C5 and 50C5 are designed for use in the output stage of a.c.-d.c. receivers. They are capable of providing 1.5 watts and 1.9 watts, output respectively, with only 110 volts on plate and screen.

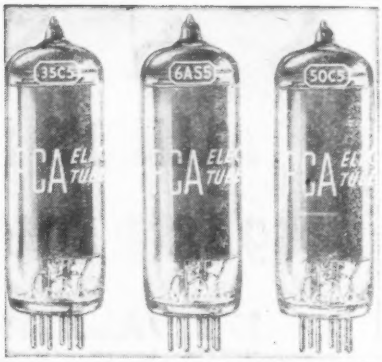
Except for slightly higher voltage ratings, and a different basing arrangement, the 35C5 and 50C5 are the same as the types 35B5 and 50B5. They are also, within their maximum ratings, the performance equivalents of the 35L6-GT and 50L6-GT. The typical operation characteristics of the 6AS5 and the maximum ratings of the 35C5 and 50B5 are shown in the following tables:

6AS5

Heater:		
Voltage (a.c. or d.c.)	6.3	Volts
Current	0.8	Ampere
Typical Operation:		
Plate Voltage	150	Volts
Grid No. 2 Voltage	110	Volts
Grid No. 1 (Control-Grid) Voltage	-8.5	Volts
Peak AF Grid No. 1 Voltage	8.5	Volts
Zero Signal Plate Current	35	Milliamperes
Max. Signal Plate Current	36	Milliamperes
Zero Signal Grid No. 2 Current (Approx.)	2	Milliamperes
Max. Signal Grid No. 2 Current (Approx.)	6.5	Milliamperes
Transconductance	5600	Micromhos
Load Resistance	4500	Ohms



The "Special Red" long-life filament tubes.



Miniature output tubes 35C5, 6AS5 and 50C5.

Total Harmonic Distortion	10	Per cent
Max. Signal Power Output	2.2	Watts

35C5

Maximum Ratings, Design-Center Values:		
Plate Voltage	135 max.	Volts
Grid No. 2 (Screen) Voltage	117 max.	Volts
Plate Dissipation	4.5 max.	Watts
Grid No. 2 Dissipation	1.0 max.	Watt
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	180 max.	Volts
Heater positive with respect to cathode	180 max.	Volts
Bulb Temperature (at hottest point on bulb surface)	250 max.	°C

50C5

Maximum Ratings, Design-Center Values:		
Plate Voltage	135 max.	Volts
Grid No. 2 (Screen) Voltage	117 max.	Volts
Plate Dissipation	5.5 max.	Watts
Grid No. 2 Dissipation	1.25 max.	Watts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	180 max.	Volts
Heater positive with respect to cathode	180 max.	Volts
Bulb Temperature (at hottest point on bulb surface)	250 max.	°C

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The new free-point system described above permits the Model 247 to overcome the difficulties encountered with other emission type tube testers when checking Diode, Triode and Pentode sections of multi-purpose tubes, because sections can be tested individually when using the new Model 247. The special isolating circuit allows each section to be tested as if it were in a separate envelope.

The Model 247 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R. M. A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Model 247 comes complete with new speed-read chart. Comes housed in handsome, hand-rubbed oak cabinet sloped for bench use. A slip-on portable hinged cover is included for outside use. Size: 10¾" x 8¾" x 5¾".

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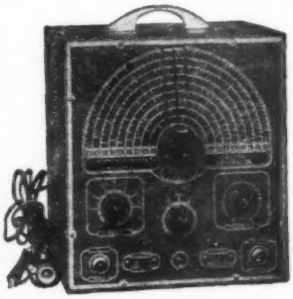

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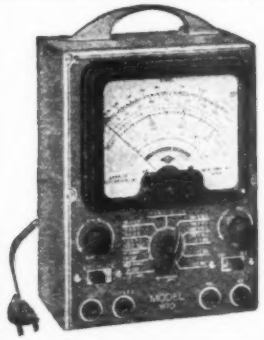

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TUBELESS HOMO-HETERADIO

(Continued from page 23)

slightly out of step, will at certain times reinforce, at others neutralize each other. This alternate reinforcement and neutralization takes place at a frequency which is the *difference* between the two frequencies. Thus, by *heterodyning* an inaudible 500-kc signal (for instance) with an equally inaudible one of 501 kc, an audible 1-kc (1,000-cycle) note is produced. This principle is still the standard method of receiving continuous-wave telegraph signals.

In the Heteradio, the supersonic sound frequency is adjusted to *exactly* the carrier frequency of the incoming wave. For example, to receive a station on 1,000 kc, the sonic generator is set to that frequency. It is then at *zero-beat*, and *as long as the carrier is unmodulated*, nothing will be heard. As soon as modulation is applied, *sidebands* appear above and below the carrier, and these are heterodyned by the siren. For example, if a 100-cycle note is sounded on an instrument at the 1,000-kc station, a frequency of 1,000,100 and 900,900 cycles appears as well as the original 1,000-kc (1,000,000 cycles) of the carrier. The siren heterodynes with both of these to produce a note of 100 cycles. A symphony orchestra is reproduced in the same manner. See Fig. 1 page 23.

Since the strength of a signal reproduced by the heterodyne method depends on the product of the received and the heterodyning signal, the power output can be made very great by selecting a siren of desired size and output.

Now, when the proper adjustment is made on the Heteradio rheostat a point will be reached where the supersonic siren waves will clash with the radio frequency waves. A careful adjustment is made with the rheostat whereby the siren waves will be at *dead beat* with the radio waves. The result now becomes audible through the sound loud speaker cone shown in illustration, page 22.

This siren draws its air supply from a horn-shaped collector which is turned in the direction of the broadcast station. As pointed out, the molecules of air are acted upon by these waves, actually being set into mechanical motion. *Thus the air stream drawn into the siren is actually modulated with the program transmitted by the station.*

This sounds much more complicated than it actually is and once you understand the theory you will ask yourself why it had not been done long before. The answer is that, like all important inventions, no one had thought of it before.

I next calibrated my rheostat to read not in the speed of the motor, but in kilocycles as shown in the illustration. To tune the set to receive the various stations, I merely turn the rheostat from one point of the scale to the other. In this way I can do fine tuning so that whatever broadcast station I wish to get, I tune in, just as I would tune any regulation radio set—it is that simple.

The housing which contains the motor and the siren is formed from a plastic shield. The housing thus becomes a wave mixer. In order to get the maximum effect—since my sound collector is highly directional—I revolve the entire housing with its two cones by means of gears attached to a dial. Thus the wave apparatus can be rotated through 180 degrees around its axis. At certain points radio broadcast stations will come in much stronger than at others, as would be expected. The same thing occurs with a standard portable radio that has a loop aerial; stations will come in better in one position of the set than in another.

My mechanical radio receiver works in a like manner. I had no difficulty in bringing in all the local stations after I had built in certain refinements in my wave apparatus.

In order to show how the wave action works out in practice we have added a diagram which explains the Homo-Heterodyne feature. See page 22.

You may ask: where is the volume control? There isn't any, except the rotating control that spins the wave apparatus on its axis. At the best point on the compass the sound issues loudest. At right angles to this, the volume is weakest.

How loud is the loudest station? Not quite as loud as a regulation radio set, but good enough to hear the stations all over the room. If more intensity of sound is required it would be necessary to build a somewhat larger siren in order to obtain more volume. That is the only way that sound intensity can be increased with the Tubeless Homo-Heteradio.

You will appreciate that the set described here is one of my early models and that other refinements will come

(Continued on page 64)

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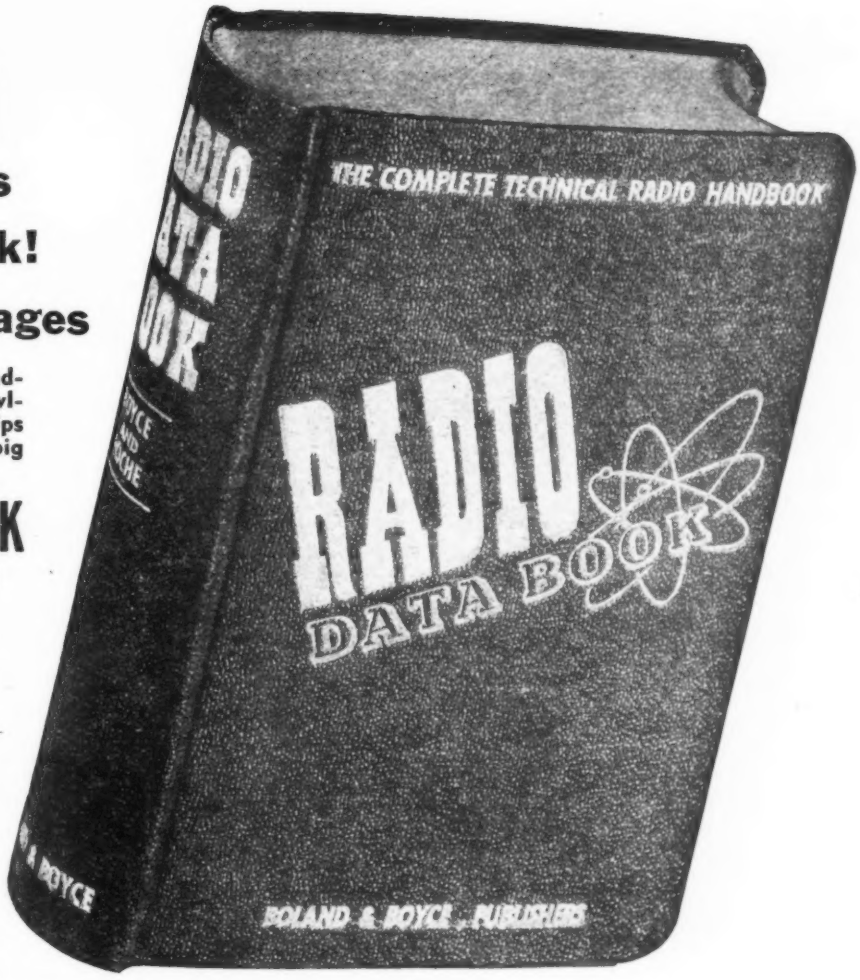

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TUBELESS HOMO-HETERADIO

(Continued from page 62)

later. Note that the receiver which I have shown in these pages is *purely experimental and does not represent a model such as will be built later and sold to the public.*

Here are a few things that I must mention, in connection with the Homo-Heteradio.

Experimenters building this receiver will have to be very careful because at a certain point in the supersonic spectrum one runs right smack into an unknown field. ***There are human risks in the supersonic siren.***

These were recently reported by Drs. C. H. Allen, H. Frings, and I. Rudnick, of the Pennsylvania State College.

While the siren cannot be heard by human ears, after a while, a person close to it gets dizzy. *At certain supersonic speeds the sound kills insects by overheating their bodies. Indeed, at certain frequencies the siren heats anything the sound blast touches.*

I had no trouble with my own siren because it runs at far greater speed than the normal supersonic whistles or sirens. But, if you experiment with it, necessary caution must be taken.

I must further report an incident which greatly grieves me and which shows once more that the path of the pioneer is not easy nor strewn with roses. I was asked to give a lecture on my new tubeless radio invention before a number of radio manufacturers at the New York State Radio College recently. A big crowd had assembled to listen to my revolutionary new radio receiver and after a successful demonstration there was a tremendous amount of excitement among the milling crowd, who closely inspected my Tubeless Homo-Heteradio.

In order to answer a number of questions, the audience was seated again, while I proceeded to the blackboard in order to explain certain technical phases of the Heteradio.

In the midst of the lecture I was shocked beyond words when suddenly someone started to shoot at my Heteradio which was standing on a table at my right. It seems the madman had concealed a machine gun and it only took a few bursts to wreck every vestige of my receiver. I then heard a lot of angry talk that a receiver of this type would certainly wreck the entire radio industry.

Evidently some fiend who thought I would take away his livelihood was bent on killing me, so I promptly took refuge under the table near the blackboard. Just then another round of bullets whizzed above me. There ensued a panic in the audience and in a few seconds the hall was cleared.

After a few minutes I ventured from my hiding place beneath the table. Just then there was another sound of something falling down—right beside me. I looked around, but there was no one in sight. Shaking and stupefied at the near tragedy I picked up the object that had fallen from the wall. It proved to be a large leaf calendar, such as used in schools. I picked it up gingerly. It had been riddled with bullets, but the date still remained intact. Mockingly it read:

APRIL 1.

TINY SELF-POWERED ELECTRONIC VOLTMETER

(Continued from page 24)

little device, voltage multiplier and signal tracer probes were constructed. The voltage multiplier probe (Fig. 2) extends the range up to 5,000 volts, multiplying the existing ranges 10 times. With this probe, the effective input resistance is 75 megohms. The signal tracing probe (Fig. 3) makes it possible to use this instrument for simple r.f. and a.f. measurements. It cannot be used for exact a.c. measurements since the rectification efficiency of a crystal diode probe is not constant for varying voltages, and the d.c. output is not proportional to the a.c. input. Nevertheless it is very useful for making comparative gain measurements and checking antenna efficiency. For best results, voltages measured with this probe should not exceed 50. The effect of plate current on the meter is neutralized by applying some of the filament voltage across it through the 1,000-ohm potentiometer. The potentiometer is varied till the meter reading is reduced to zero.

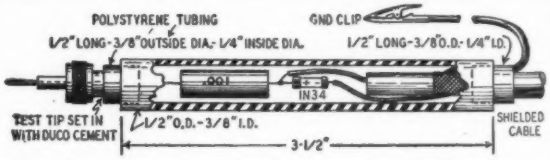

Fig. 3—This probe makes a signal tracer out of the v.t. voltmeter. The 1N34 rectifies radio and audio frequency at all signal levels.

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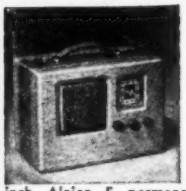

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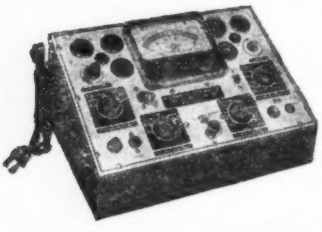

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BRITISH RADIO DESIGN

(Continued from page 27)

In contrast to these, the Murphy U 102 seen in accompanying photographs may be described as the serviceman's joy. The chassis stands vertically in the tall, narrow cabinet, and can be withdrawn simply by removing 4 screws. The projecting metal straps permit its being placed in any position on a workbench without the risk of damaging tubes, components, or wiring. Every part of every circuit is completely accessible. Another advantage of this type of construction is that the tuning scale and tuning drive are rigidly mounted without brackets.

Higher-class equipment

Turning to the more expensive receivers, the Ekco A 28 in Fig. 3 is one of the most interesting designs. The circuits of this set are by no means simple. Basically it is a superheterodyne with a magic-eye tuning indicator. Its complexities are the band-switching and band-spreading arrangements, the tone control, the whistle filter, and the negative-feedback circuit. Besides the broadcast and long-wave bands with push-button tuning on 5 stations, the set covers the short waves from 5.8 to 21.7 mc and receives the sound accompanying television on 41.5 mc.

There are no less than 7 short-wave bands, each with full-scale tuning. As soon as the 13-gang band switch is tuned to one of the short-wave positions, the 2-gang variable tuning capacitor C1, C2 is automatically cut out; the oscillator is changed to the Colpitts type, and the ganged iron-dust cores of the master inductances L1 and L2 are moved inward or outward by the tuning drive. With this arrangement short-wave stations are as easy to tune in as those in the broadcast band. The 41.5-mc television sound channel is fixed-tuned, the second harmonic of the oscillator being used in conjunction with a setting on the 21-mc band.

With the European 9-kc separation between broadcasting channels, heterodyne whistles are apt to be troublesome. This receiver eliminates them with an acceptor filter tuned to 9 kc in the plate circuit of V4. It is a .005-μf condenser in series with a large iron-cored coil. Negative feedback is carried out by means of a third winding on the output transformer. The feedback to the grid of V3 is divided into 2 branches, one going to a treble-boost filter and the other to a bass-boost filter. Both are continuously variable. The user can adjust the tone balance of the 10-inch loudspeaker's output to his own liking.

An interesting short-waver

The last example is the Murphy A-104, a set designed to simplify tuning on the short waves. This again is a 4-tube-plus-rectifier set, only the circuits of the first 2 tubes being shown in Fig. 4. It achieves ease of tuning on the short waves comparable to that of the Ekco A28 by simpler and less expensive methods. The band switch, for instance, has only 5 gangs with 15 live contacts, in the place of 13 gangs with 59 live contacts. There is but a single short-wave range, but so good is the band spreading on this range that the effective length of the tuning scale is over 50 inches! When the switch is turned to the short-wave position a window in the front panel lights up. On this is projected the optically magnified image of a portion of the scale. The actual scale is photographed on a glass plate fixed to the spindle of the 2-gang variable tuning capacitor and moves with it. Concentric with the main tuning knob is a smaller one, which controls the movement of a plunger in the oscillator plate tuning coil. A hairline indicator, yoked to the plunger, moves over the enlarged scale appearing in the window. The optical and electrical components are so well co-ordinated and the band spreading is even over the whole range and a station once logged always reappears at the same dial setting.

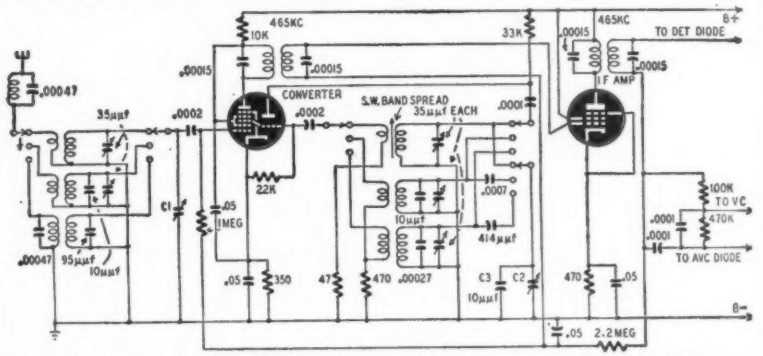

Fig. 4—The simple r.f. end of the Murphy A-104. Its tuning scale is over 50 inches long.

Later I hope to describe further British radio and television receivers. Some very interesting new types of both are coming along.

A handy hearing aid is reported by W. B. Hutchins of San Antonio, Texas. Besides acting satisfactorily as a hearing aid, it also brings in the programs of local station KFYM, which is about a block from Mr. Hutchins' place of business.

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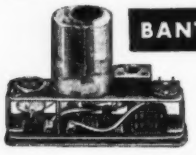

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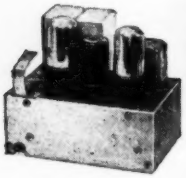

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INTRUDER ALARM

(Continued from page 25)

age appears on its grid as negative bias. Under normal conditions, the 50L6 plate current is just sufficient to throw the relay.

A 50,000-ohm, wire-wound control permits the screen-grid voltage to be varied from 90 to about 115, thus controlling the sensitivity of the unit by varying the amplification of the 50L6.

When anyone nears the feeler, the oscillator is detuned and the plate current rises, producing a greater voltage across R1. The 50L6 plate current is cut off or reduced to a point where the relay drops out, opening or closing the external alarm or control circuits connected to the relay contacts.

The relay is an 8,000-ohm, s.p.d.t. unit designed to close at 3 ma and open at 0.6 ma. It was made by Sigma and is a popular surplus item. Its armature and movable contact are connected to the frame, so we mounted it on insulating material before fastening it to the chassis. Other relays of equal sensitivity will work just as well, of course. Remember that the relay is tripped under normal operation. If you want an external circuit to close when the capacity relay operates, the plate relay should have normally closed or double-throw contacts. Contacts on sensitive relays are seldom designed to carry more than 1 amp; use an auxiliary relay if heavier current flows in the controlled circuit.

The unit was built on a 7 x 4 x 2-inch metal chassis. The third tube shown in the photograph is not used. The chassis was left over from previous experiments, so a dummy was plugged into the empty socket to improve the appearance of the unit. The electrical circuit is isolated from the chassis to avoid possibility of shock. Some constructors may find it advisable to shield the entire control unit so the relay will not trip when you approach it.

Operation and adjustment

When the unit is wired and checked, turn it on and measure the voltage between the 12J5 grid and the bottom of the oscillator coil. Be sure to use a v.t.v.m. or sensitive d.c. voltmeter—20,000 ohm per volt or better. Voltage at this point indicates oscillation. We measured 5 volts at this point with a v.t.v.m., but voltage varies with different tubes and operating conditions.

(If the oscillator is adjusted to about 550 kc, you can check for oscillation by listening for the fundamental or harmonics on a near-by broadcast set.—*Editor)*

With C1 at full capacitance, resonate the plate circuit. Resonance can be indicated by temporarily connecting a low-range d.c. milliammeter between the plate coil and R1.

If the relay has adjustable contacts, adjust them so there is very little space between the armature and fixed contact when the relay coil is excited. This adjusts the plate relay to its most sensitive point.

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Attach the antenna or feeler, and open C1 *slowly* until the relay armature is attracted. *Keep away from the feeler when making this adjustment.*

When the unit is properly adjusted, there is about 35 volts of bias on the 50L6. When anyone approaches the feeler, this voltage rises to about 40, cutting off plate current and releasing the relay. These voltages vary slightly with different tubes, so try different ones if you have trouble with the circuit. Other combinations of tubes can be used by selecting the proper filament dropping resistor.

TRANSATLANTIC NEWS

(Continued from page 38)

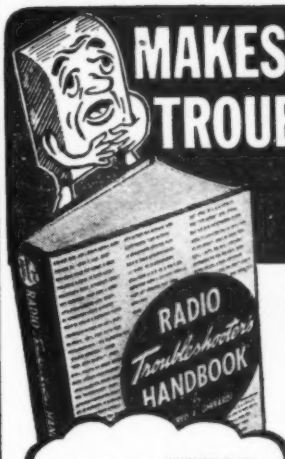
important aids to radar mapping. Thanks largely to the miniature radio tube, it is now so small and light that the ground survey parties can transport and install it, even in the most difficult country—and a small number of radio beacons, accurately placed, makes it possible to survey a vast tract of land from the air.

Table lamp radio

The latest type of invisible home radio hails from France. It looks exactly like any ordinary table lamp, with a frilly silk shade. But built into the pedestal is a 3-tube superheterodyne. The loudspeaker (concealed by the shade) is just below the light-bulb socket, and the wire frame supporting the shade forms the antenna. The set is intended only for local reception. A single small knob operates preset tuners to give a choice of 5 stations. The idea of a table lamp radio is not new. I recall reading about 25 years ago in an American magazine an article called "Reading by Audion Light." It describes a receiving set, using the original battery-operated audions, made in the form of a hanging lamp. The 5 tube sockets were arranged so that the tubes were upside down and threw all the light from their filaments on to the table below. As the audions were bright emitters requiring about ¾ amp at 4 volts for their filaments, the 15 watts consumed by the 5 tubes in the set should have given the ingenious inventor quite a reasonable amount of light for his reading.

The French government levies a tax on all radios—500 francs on the first one, and 100 francs for each additional set. In return it is responsible for eliminating all sources of noise interference from the radio. Thirty technicians—members of the government's "parasitic service"—cover Paris and the surrounding area to check on all reports of interference. About 7,000 investigations are made each year.

Locating the trouble is not easy, since all electric conductors and appliances are possible transmitters of parasitics. Frequently, the interference comes from a doctor's old-fashioned diathermy machine or an electric razor. The owners of these noisemakers are legally subject to fines and imprisonment, but those who refuse to correct abuses are the most likely to be punished.



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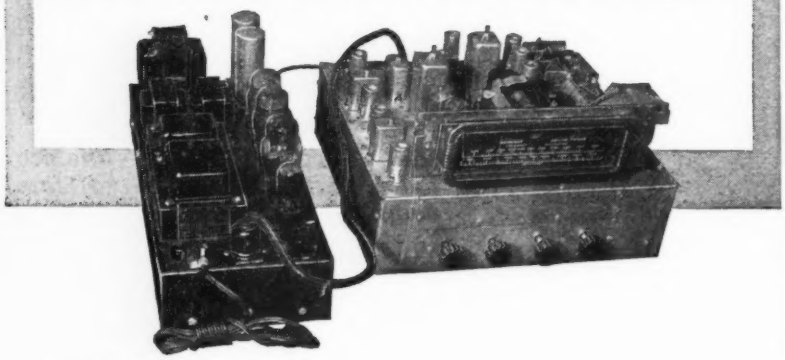

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Audio fidelity, flat within plus-minus 2db. from 50 to 15,000 CPS.

Frequency ranges, 535 to 1620 KC. (AM Band) and 88 to 108 MC (FM Band).

Hum level, 65 db. below full output.

Sensitivity, less than 20 microvolts.

Phonograph Input, compensated for either magnetic or crystal pickup.

Tone Control, combination control provides bass boost up to 11db. at 40 CPS and treble attenuation up to 13db. at 10,000 CPS.

Power Supply, 105 to 125 volts, 50-60 cycle. Consumption, 190 Watts.

Tube complement, 3 type 6SK7, 1 type 6SA7, 1 type 6H6, 5 type 6AG5, 1 type 6C4, 2 type 9001, 1 type 6AL5, 2 type 6J5, 1 type 6U5/6G5, 1 type 6SN7GT, 2 type 6L6, 1 type 5Y3G and 1 type 5V4G.

Chassis Weight, tuner, 18 pounds, amplifier, 27 pounds.

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CORRECTION: The grid of V120A in the RCA 630TS Televiser Schematic, January, 1948, page 49, should be connected to pin 1, not pin 4 as shown.

TONE CONTROL
(Continued from page 35)

low end or the high end? Aren't tone controls desirable to compensate for unbalance in other parts of the system?" That argument is right and proper, so I shut up.

I breadboarded. I spent my evenings for some time reading up on controls, trying them out and wondering what made them work. Finally I saw what was going on. All I wanted was an a.c. voltage divider that used reactances in one leg. Something that would give a different ratio at one frequency than at another.

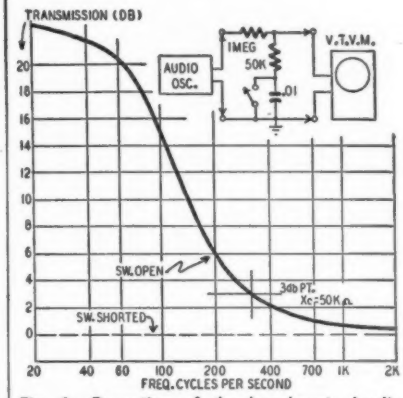

Fig. 2—Operation of the bass-boost circuit.

This is what I ended with: Fig. 1 shows the basic circuit for lows. Close the switch and you have a normal voltage divider.

$$\text{Output is } \frac{R2}{R1 + R2} \times \text{input.}$$

Now let's open our switch—the condenser then comes into the circuit. At low frequencies the reactance is high and we have an output:

$$\frac{\sqrt{R2^2 + XC^2}}{\sqrt{(R1 + R2)^2 + XC^2}} \times \text{input.}$$

We can easily pitch that anywhere we want by juggling the size of C and R2. We will end with a curve like Fig. 2. The bass rise will start up and be 3 db where the reactance of C equals R2. It will go up at a rate that approaches 6 db per octave until it starts to level off. The leveling-off spot (3 db from the top) will be where R1 equals the impedance to ground or $(R2^2 + XC^2)^{\frac{1}{2}}$.

O.K. you say, but you're still not boosting the bass! You're just cutting down the treble. That's right, but you don't have to look at it that way. You can say this is a filter with an insertion loss of N db. When the switch is flipped, you get a bass boost of 0.8N db. Try it and see. You can make the resistors 1 meg and 50,000 ohms, which will give an insertion loss of 26 db and a bass boost of approximately 20 db (when you flip your switch). Make C a .01-μf condenser, and the bass rise will start around

400 cycles and go up very nicely. What's that? You want smooth control and not 20-db boosts? Okay, take out the switch and put in a potentiometer. Try a 500,000-ohm pot and see how nicely you can bump up the bass in your radio programs.

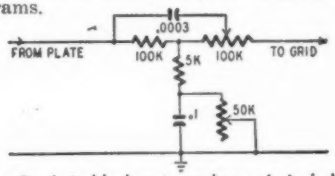

Fig. 3—A treble boost condenser is included.

How about treble? Easy! Now we want a series condenser instead of one to ground. Let's put an isolating resistor at the output of our bass booster and run a condenser across it to the input of the next stage. Since we have pretty high resistances it will have to be a small condenser to have just the highs affected, so let's cut everything down by 10. We can use a 100,000-ohm, series-dropping resistor, 5,000 ohms in the leg to ground and, a bass condenser of 0.1 μf. Then let's use another 100,000 ohms to isolate the back end, and fool around with different-sized condensers for the treble. A .0003 mica seems about right. The treble rise begins around 2,500 to 3,000 cycles. Amazingly enough, that's where the reactance of the .0003 condenser equals the 200,000 ohms in parallel with it. Fig. 3 shows how it works.

That one can be made smoothly adjustable too. Let's make the isolating resistor a 100,000-ohm variable. Then the condenser will slide back to where our bass-boost voltage divider will keep any highs from getting through, or slide up toward the next grid where our highs will pound out like mad.

Here's something to remember: if you keep your resistances and reactances in the same proportion, you can multiply your constants by 10 or 1/10 or anything else. That means you can juggle things around to suit varying conditions. If this circuit is to follow a triode with low plate impedance, keep the 100,000 ohms, 0.1 μf, and 5,000 ohms. If you are using a pentode, you'll lose gain with it because a pentode likes a higher load resistance. O.K. then, change to 1 megohm and .01- and 50,000-ohm values. It'll still act the same. If you want your bass or treble boosts to come lower in the audio band, just increase the capacitance a bit; if you want higher boosts (louder, I mean), juggle your resistance ratio. I prefer these sample values because they suit my ear and my turntable rumble. Don Lee put out something like $1,500 for his turntables because he wants the rumble to be very low. Us guys with our $10 motors —we can't boost our bass too much or we listen to rumble instead of music. Don't forget, too, that we are throwing away gain with this business. We throw away 26 db with these constants and get about 20 db back at the extreme ends of the band. Our middle is still down 26 db. So let's plan on having an extra 26 db of gain somewhere else in our system.

(Continued on page 72)

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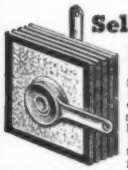

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C8116AD	C8120AD	250,000
C8117AD	C8121AD	500,000
*C8113AD	*C8126AD	500,000
C8118AD	C8122AD	1 megohm
*C8105AD	*C8127AD	1 megohm
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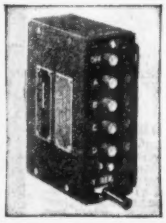

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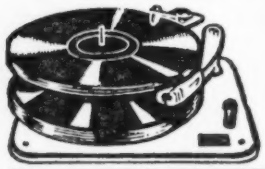

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TONE CONTROL

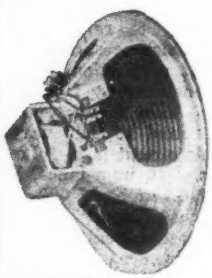
(Continued from page 71)

Another thing. This whole system merely illustrates a method of correcting tone. You can use any part of it anywhere in an amplifier if you keep your levels and impedances in mind. To get 1 volt out at 1 kc, you have to put in 21 volts. So don't try to get 20 volts out. Not many tubes will put 400 volts in. Also if you run in a millivolt, you'll get only about 1/20 millivolt out; and that's pretty low, and you may have troubles with hum.

The hum has to be kept down with any system that boosts bass. You can shield your early filaments or even use d.c. if the level is very low and you want a lot of bass. Care in layout and wiring is most important. A 100-ohm potentiometer across the filament leads with the center to ground is handy. Most filament center taps aren't at the center, and you can balance out hum beautifully with a potentiometer. This was standard practice in the old receivers which used 26's and 45's in the audio end, and some of them had pretty good quality!

We arrived at this particular system by trial and error and fooling around. Others have also arrived at it. In case you never ran across it or in case you never understood it—here it is. The controls are completely independent of each other, and you'll be pleased with the way it works.

APRIL SPECIALS



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FM STATION LIST

(Continued from page 40)

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97.1	WRCM	New Orleans, La.
97.1	WTCN-FM	Minneapolis, Minn.
97.1	WWJ-FM	Detroit, Mich.
97.3	KTRN	Wichita Falls, Texas
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97.3	WNBC-FM	New York, N. Y.
97.3	WROL-FM	Knoxville, Tenn.
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97.3	WTOC-FM	Savannah, Ga.
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97.5	WLVA-FM	Lynchburg, Va.
97.9	KFAB-FM	Lincoln, Nebr.
97.9	WBTM-FM	Danville, Va.
97.9	WEHS	Chicago, Ill.
97.9	WFAA-FM	Dallas, Texas.
97.9	WGYN-FM	New York, N. Y.
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97.9	WLPM-FM	Suffolk, Va.
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97.9	WMRF-FM	Lewistown, Pa.
97.9	WRNY-FM	Rochester, N. Y.
97.9	WWPG-FM	Palm Beach, Fla.
98.1	KQV-FM	Pittsburgh, Pa.
98.1	KOZY	Kansas City, Mo.
98.1	KRSC-FM	Seattle, Wash.
98.1	WBRL	Baton Rouge, La.
98.1	WCAU-FM	Philadelphia, Pa.
98.1	WCOD-FM	Richmond, Va.
98.1	WFMR	New Bedford, Mass.
98.1	WFNC-FM	Fayetteville, N. C.
98.1	WSAL	Saginaw, Mich.
98.3	KAGH	Pasadena, Calif.
98.3	WEEX	Easton, Pa.
98.3	WHNY-FM	Hemstead, N. Y.
98.3	WLAD-FM	Danbury, Conn.
98.3	WPIK	Alexandria, Va.
98.3	WTFM-FM	Tiffin, Ohio
98.5	KBIX-FM	Muskogee, Okla.
98.5	KLOK-FM	San Jose, Calif.
98.5	KOPY	Houston, Texas
98.5	WAGE-FM	Syracuse, N. Y.
98.5	WBRE-FM	Wilkes-Barre, Pa.
98.5	WCBT-FM	Roanoke Rapids, N. C.
98.5	WHLD-FM	Niagara Falls, N. Y.
98.5	WJPF-FM	Herrin, Ill.
98.5	WNAM-FM	Neenah, Wis.
98.7	KDYL-FM	Salt Lake City, Utah
98.7	KVWC-FM	Vernon, Texas
98.7	WBAM	New York, N. Y.
98.7	WCTP	Greensboro, N. C.
98.7	WGNB	Chicago, Ill.
98.7	WHOP-FM	Hopkinsville, Ky.
98.7	WJNO-FM	West Palm Beach, Fla.
98.7	WPAG-FM	Ann Arbor, Mich.
98.7	WSOY-FM	Decatur, Ill.
98.7	WWVA-FM	Whceling, W. Va.
98.9	KJBS-FM	San Francisco, Calif.
98.9	WCOA-FM	Pensacola, Fla.
98.9	WHBF-FM	Rock Island, Ill.
98.9	WHFM	Rochester, N. Y.
98.9	WKBN-FM	Youngstown, Ohio
98.9	WKY-FM	Oklahoma City, Okla.
98.9	WSNJ-FM	Bridgeton, N. J.
98.9	WSPA-FM	Spartanburg, S. C.
99.1	KUGN-FM	Eugene, Ore.
99.1	KWK-FM	St. Louis, Mo.
99.1	WDOS-FM	Oneonta, N. Y.
99.1	WGTR	Boston, Mass.
99.1	WHIO-FM	Dayton, Ohio
99.1	WMAZ-FM	Macon, Ga.
99.1	WNAV-FM	Annapolis, Md.
99.1	WSLS-FM	Roanoke, Va.
99.1	WTTH-FM	Port Huron, Mich.
99.3	KGAR-FM	Garden City, Kan.
99.3	WBBM	Chicago, Ill.
99.3	WFRO-FM	Fremont, Ohio
99.5	KISS	San Antonio, Texas
99.5	KRIC-FM	Beaumont, Texas
99.5	KTSJ	Topeka, Kan.
99.5	WABF	New York, N. Y.
99.5	WAFM-FM	Birmingham, Ala.
99.5	WEFM	Chicago, Ill.
99.5	WJLS-FM	Beckley, W. Va.
99.5	WGFM	Schenectady, N. Y.
99.5	WMFR-FM	High Point, N. Y.
99.5	WMIN-FM	St. Paul, Minn.
99.5	WNLC-FM	New London, Conn.
99.5	WSON-FM	Henderson, Ky.
99.7	KPDR-FM	Alexandria, La.
99.7	KTFI-FM	Twin Falls, Idaho
99.7	WCJT	Louisville, Ky.
99.7	WJAS-FM	Pittsburgh, Pa.
99.7	WMC-FM	Memphis, Tenn.
99.7	WSAP-FM	Portsmouth, Va.
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99.9	KMYC-FM	Marysville, Calif.
99.9	KVEC-FM	San Luis Obispo, Calif.
99.9	WBT-FM	Charlotte, N. C.
99.9	WCLO-FM	Janesville, Wisc.
99.9	WERC-FM	Erie, Pa.
99.9	WFNS-FM	Burlington, N. C.
99.9	WHFB-FM	Benton Harbor, Mich.
99.9	WKRG-FM	Mobile, Ala.
99.9	WKRT-FM	Cortland, N. Y.
99.9	WSAN-FM	Allentown, Pa.
99.9	WTRT-FM	Toledo, Ohio.
00.1	WKBR-FM	Manchester, N. H.
00.1	WLBR-FM	Lebanon, Pa.
00.1	WMUS-FM	Muskegon, Mich.
00.3	KGW-FM	Portland, Maine
00.3	KMPC-FM	Hollywood, Calif.
00.3	KSL-FM	Salt Lake City, Utah
00.3	WACE-FM	Chicopee, Mass.
00.3	WCLT	Newark, Ohio
100.3	WGBG-FM	Greensboro, N. C.
00.3	WHO-FM	Des Moines, Iowa
00.3	WMGM-FM	New York, N. Y.
00.3	WSAV-FM	Savannah, Ga.
100.3	WWLH	New Orleans, La.
100.5	KSBR	San Bruno, Calif.
100.5	KMBC-FM	Kansas City, Mo.
100.5	WHMA-FM	Anniston, Ala.
100.5	WHTN-FM	Huntington, W. Va.
100.5	WMNE	Boston, Mass.
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(Continued on page 79)

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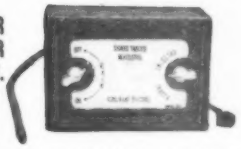

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AMATEUR RADIO LICENSES. COMPLETE CODE and theory preparation for passing amateur radio examinations. Home study and resident courses. American Radio Institute, 101 West 63rd Street, New York City. See our ad on page 86.

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THE RADIOMAN EXPANDS

(Continued from page 20)

"Your business methods are sound, your deposits have shown an above-average increase, and we are willing to supply the financial aid required." Need more be said? From the jobber, "The outlook for your type of service looks good. Go ahead." From the businessmen, "We wouldn't be expanding ourselves if we didn't think it wise."

Once the decision to expand has been made, don't become overly optimistic, because the work has only just begun. The next step should be to determine *which* facilities need to be expanded and *to what extent.* In our individual case, we own our present building, which was built to our specifications immediately following the close of the war (see RADIO-CRAFT, March, 1947). The size of this building was determined entirely by the amount of materials available at the time and was necessarily smaller than we desired. However, we kept the thought of future expansion in mind, and designed this original structure in such a way that future additions would not detract from the unique features incorporated in it.

A review of our records showed us that our auto radio service was growing by leaps and bounds. This meant that to continue to handle this service on a year-round basis drive-in facilities would have to be incorporated in our new building. This drive-in had to be arranged so that it would not interfere with the floor space required for additional shops in which to house our rapidly growing personnel. Our final plan called for drive-in space to handle three autos under cover and three glassed-in service shops identical to the one in our original building.

The next step was to prepare detailed scale floor plans and specifications. We were fortunately able to prepare these ourselves, thus saving architectural expenses and also assuring us that our windows, lighting fixtures, and structural supports would be placed where we wanted them. At this point, it began to look like the deck hadn't been shuffled very well because the next two cards we drew were jokers. These jokers were in the form of estimates prepared from identical plans and specifications. One for slightly over $4000, the other a few dollars under $2000. Again we called upon our friend, the banker, for advice. He assured us that both men were of equal integrity and ability so we chose the lower bid of the two. We later learned that the contractor submitting the higher bid maintained his own material supply yard with several employees here and a large clerical staff to prepare his cost estimates, while the other one worked from his home and all of his employees were "on the job workers."

After the contractor moves in you might feel that your worries are over, but you have many headaches in store yet. Material shortages, delays, bad weather, and many other unforeseen problems continue to arise.

But eventually everything is completed. You at last relax in an easy

chair, place your feet on the desk, and doze intc a dream of what a nice little business you have when suddenly you are rudely awakened by the thundering calm chat has decended on the old place. A quick survey shows you that with extra floor space, added employees, and increased efficiency, the boys are no longer dashing around at a mad pace but are actually hunting for a job to do. It is then up to you to expand your business as well.

Here are a couple of methods we have used to good advantage in securing new business as well as holding our old customers. Your remodeling or building program is news to your community, so avail yourself of the free reader publicity that your local paper will carry for you if you give them your plans and an outline of your expanded service in your locality. The following business promoter has more than paid for itself in the three months that we have had it in operation. We purchased 14 small table model radios of a well-known brand and offered a free loan service to our customers while their radio is under repairs. All of our advertising carries the catchy phrase "uninterrupted listening pleasure, you may use our radio while yours is being repaired."

Here's how it works. We charged the initial cost of these radios to equipment. They are not offered for sale, and the tag on each radio plainly states this fact. However, the basic laws of psychology tells us that the general public wants something they can't have. This results in a great number of sales with no effort on your part. When one of these radios is sold, it is immediately replaced. The profits from this sale are placed in an equipment reserve and used to maintain these radios.

HI-FI 35-WATT AMPLIFIER

(Continued from page 33)

the special feedback winding. (The Stancor A-3851 and Thordarson T-17S13 are examples.) It should be rated at 35 watts at least. Plate-to-plate impedance should be 6,600 ohms.

The amplifier is built on a 12 x 17 x 3-inch chassis. Controls from left to right are: master gain, No. 1 microphone gain, No. 2 microphone gain, phono gain, radio gain, treble control, and bass control.

Point-to-point wiring is used throughout, with all components securely fastened to the chassis. All controls and input leads are shielded to keep hum pickup at a minimum. All circuit values were carefully calculated and should be adhered to if duplicate results are to be expected.

In actual operation, music and speech are reproduced with a clarity seldom heard in an ordinary public address system.

Readers will note that manufacturers do not recommend the use of 6L6's at the ratings given in this article, though such ratings have been deemed permissible in the past. Cautious constructors might reduce voltages to bring power output down to about 25 watts or—possibly even better—use 807's in place of the 6L6's.

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1A5	.49	6AG7	.99	6V6GT	.89	36	1.10	803	8.95	2050	.90
1A7GT	1.10	6AK5	.69	6Y6G	.89	37	.69	804	6.75	2051	.49
1B24	2.49	6AL5	.99	6X4	.98	38	.89	805	3.75	5514	3.95
1B38	4.50	6AQ5	.98	6X5	.89	39/44	.59	807	1.25	7193	.39
1G4	.98	6AT6	.75	7AE7	.75	41	.69	808	2.95	8001	4.95
1G5	.44	6AU6	.89	7B7	.69	45	.64	809	1.50	8005	3.25
1G6	.98	6B4	1.29	7C4	1.50	47	.90	810	5.95	8011	2.95
1H4G	.98	6B6G	.89	7C5	.89	50B5	.89	811	1.95	8012	4.95
1L4	.89	6B8	.99	7F7	1.25	50L6GT	.75	812	3.15	8016	2.49
1R4/1294	1.29	6BG6	3.49	7L7GT	1.39	70L7	.89	812H	6.90	8020	5.95
1T4	.58	6C4	.64	10Y	.69	71A	.69	813	5.95	8025	2.95
1H5	.99	6C5	.51	12A6	.89	75	.69	814	4.39	9001	.89
1N5GT	1.10	6C6	.75	12AH7	1.10	75T	2.39	815	2.25	9002	.49
1LN5	1.92	6C21	12.95	12AT6	1.10	77	.75	826	1.75	9003	.49
1R5	1.10	6D4	.89	12BA6	.89	78	.75	829A/B	2.95	9004	.49
1S5	1.10	6D6	.75	12BE6	.89	79	1.10	830B	5.25	9005	.49
2A3	1.39	6F4	1.35	12C8	.89	80	.53	832A	2.25	9006	.49
2C22	.69	6F5	.51	12H6	.44	82	.98	833A	34.50	EE50	.79
2C26A	.75	6F6	.79	12J5	.89	83V	.89	836	1.15	HF100	6.95
2C34	.98	6F8G	.80	12K8	1.25	84	.75	837	2.50	HY75	1.25
2C40	2.60	6F7	.98	12SA7GT	.99	85	.89	838	3.75	HY615	1.25
2C44	1.75	6F8	1.10	12SG7	.89	100TS	3.00	841	.69	OZ4	1.25
2D21	.75	6G6	1.10	12SH7	.89	117L7	1.89	845	3.75	RK60	.79
2E22	1.50	6H6	.49	12SJ7	.79	117Z3	.89	860	3.00	RK72	3.50
2E25	3.95	6J4	1.50	12SK7	.69	117Z6GT	1.10	861	30.00	T20	1.95
2E30	2.25	6J5	.49	12SL7	1.10	121A	2.65	866A	.75	TZ40	2.95
2J32	20.00	6J6	.49	12SN7GT	.79	205B	4.50	872A	1.95	V70D	6.90
2J33	20.00	6J7	.89	12SQ7GT	.99	211	.98	874	1.95	VR78	.75
2JB5I	4.95	6K6	.49	12SR7	.79	215A	3.00	884	.75	VR90	.75
2X2	.69	6K7	.59	12X3	.98	217C	7.50	923	.49	VR105	.75
3A4	.49	6K8	1.25	14A7	1.10	250TH	12.95	954	.49	VR150	.69
3B7	.98	6L6	1.25	14B7	1.10	304TL	2.49	955	.49	Z225	1.95
3B22	4.95	6L6G	1.20	14H7	1.25	307A	6.25	956	.75	902	2.95
3B24	.98	6L7	.98	14J7	1.25	316	.89	957	.49	2AP1	1.95
3D6/1299	.89	6N7	.89	14R7	1.10	371A	1.39	958A	.49	3AP1	1.95
3E29	2.95	6Q5	.98	15E	1.50	371B	3.00	959	.49	3BP1	1.95
3Q4	1.10	6Q5G	.98	23D4	.49	394A	4.50	991	.50	3CP1	1.89
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RADIO SET AND SERVICE REVIEW

(Continued from page 30)

at the spot where signal is strongest. The antenna is oriented by turning the set on its side so the telescopic antenna is horizontal. The set is given a quarter-turn in each direction and the meter reading noted. The dipole should be mounted parallel to the antenna of the set for maximum signal.

Fig. 2 shows how reflected and direct signals may aid and oppose each other at the receiving antenna. Each serrated section represents one wave length. The direct and reflected signals are in phase at A, and the signal is strongest. At B, they are out of phase—do not arrive at the antenna at the same time, as indicated by the unequal wave-length sections—and the signals cancel to create a dead spot or minimum-signal area. This condition is most serious in television, where it causes ghosts, but may have a decisive effect on FM reception.

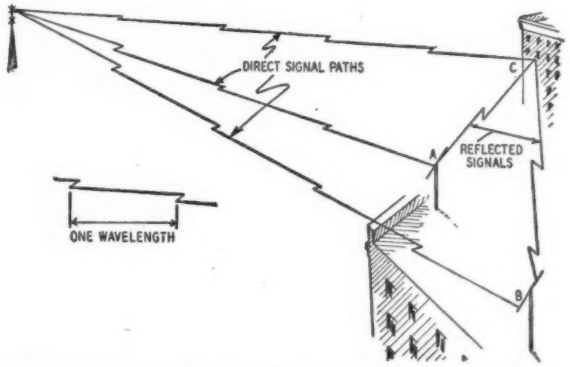

Fig. 2—Reflection aids direct signal at A but opposes it at B.

In areas where signals are generally weak, the serviceman can mount a good FM dipole on a 15- or 20-foot pole and connect it to the test receiver through a 300-ohm line. The antenna can then be moved about the roof to locate the best spot for installation.

Many FM tuners and receivers have built-in aerials. If outdoor aerials are prohibited—as they are in many apartment buildings and hotels—a serviceman should make a field strength survey inside the building to see if the signal is strong enough for good reception before completing the sale or making an installation.

While making the measurements, the test receiver should be moved around the room and the relative strength of signals from all stations in the vicinity noted. One station may come in strongest in one place in the room, and another station may be weakest at the same place. The set should be installed where it gives best reception from all stations. Loops are usually employed in sets with built-in antennas. These are often highly directional, and it is possible that the set may be placed so it will not receive desired signals with best results. The Facto Meter may be turned on end and rotated for maximum signal. The set when installed should then be so its loop is parallel to the telescopic antenna when in a position of best reception.

Fig. 3 shows how reflected and direct signals may aid or oppose inside a room. Signals may be reflected from the walls of the room just as they were from the building at C in Fig. 2. A and B have the same meaning in each drawing.

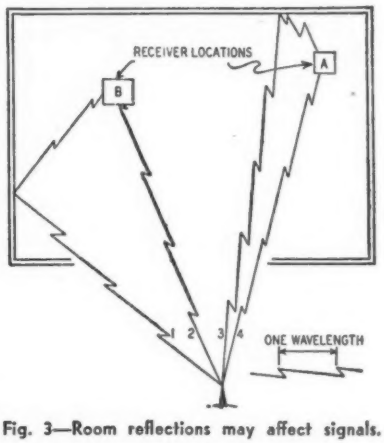

Fig. 3—Room reflections may affect signals.

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The circuit

The receiver has 8 tubes. All are used for FM, and 6 are used on AM. The tubes and their functions are: 6AG5, FM r.f. amplifier; 7F8, converter; 7AH7, first i.f. amplifier; 7AG7, second i.f. amplifier; 6H6, FM ratio detector; 6SQ7, AM detector and first a.f. amplifier; 6V6-GT, power amplifier; and a 5Y3 rectifier.

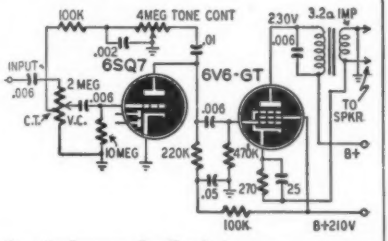


Fig. 4—Inverse feedback improves response.

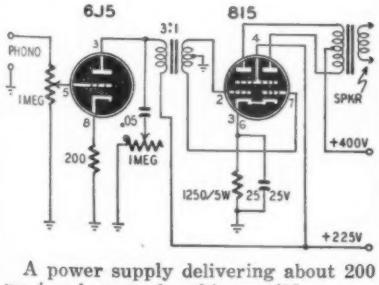
The tuning indicator is a 50-μa meter connected as a voltmeter across the a.v.c. line. A .01-μf condenser bypasses audio to ground and prevents it from affecting meter indications. Shunts are switched across the meter to vary its sensitivity.

The test set has a 4 x 6-inch oval speaker. Its tone quality is surprisingly good, considering its size and the fact that it is in a metal cabinet. The audio amplifier of the test receiver is shown in Fig. 4. Inverse feedback is applied between one side of the voice coil winding and the cathode of the power amplifier. The tone control is turned to the right for bass boost and to the left for treble boost. The circuit may be used to improve the response of phono amplifiers with small speakers.

The test receiver has a high-impedance audio output jack on the rear of the chassis. This permits it to be used as a tuner with a high-fidelity audio amplifier when making comparative tests between AM and FM reception.

2-TUBE AMPLIFIER

Here is a very compact amplifier that uses an 815 dual beam-pentode in the final stage. It is driven to about 12 watts output by a transformer-coupled 6J5 tube working directly from a phonograph pickup. The output transformer is a multi-match type and is adjusted for best results.



A power supply delivering about 200 ma is adequate for this amplifier.

The component values are not critical, and the entire unit can be built from junk-box and surplus parts in a few hours.

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.25	4000V	2.75	.00025	5000V	.87
.25	6000V	4.00	.0004	2500V	.22
10x.25	600V	1.00	.0005	2500V	.22
.5	600V	.28	.00072	5000V	.89
.5	1000V	.35	.0008	5000V	.89
.5	2000V	.40	.001	2500V	.22
.75	2000V	.55	.0015	5000V	.95
.77	330VAC	.35	.002	1200V	.17
1.0	1000V	.45	.002	3000V	.66
2.0	1000V	.60	.0025	1200V	.15
4.0	600V	.60	.00275	2000V	.28
4.0	1000V	1.00	.003	2500V	.30
6.0	600V	.70	.003	3000V	.66
6.0	1000V	1.40	.004	2500V	.36
8.0	600V	.80	.005	600V	.13
8.0	1000V	1.75	.005	3000V	.66
10.0	600V	.85	.006	2000V	.35
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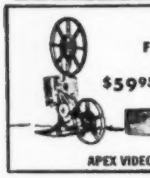

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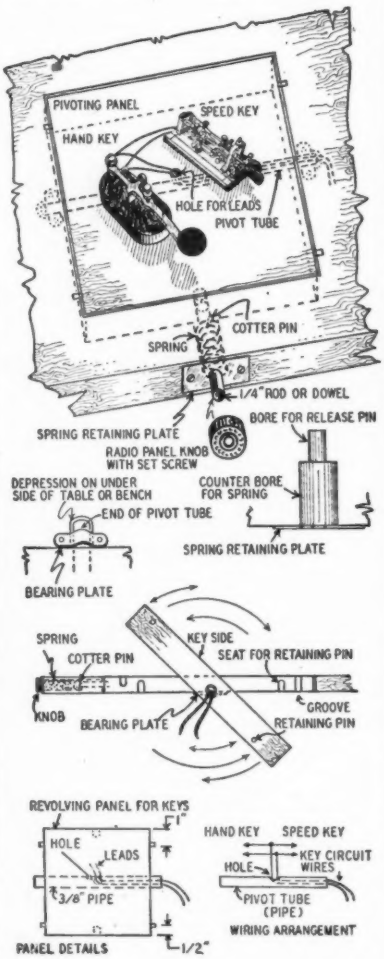
A hole was drilled through the center of the panel, as shown, and a piece of ⅝-inch brass pipe driven through it to allow about ¾-inch to project on each side. A ¼-inch hole was previously drilled in the pipe and positioned to coincide with a hole in the key side of the panel.

The panel was then fitted into the opening and the under side of the bench marked for depressions which must be cut to bring the panel flush with the table top. Small bearing plates hold the



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OR my deposit of $..... is enclosed (20% required), ship order C.O.D. for balance. NO C.O.D. ORDER FOR LESS THAN $5.00. BE SURE TO INCLUDE SHIPPING CHARGES.

Circle Item No. wanted:
147 159 160 87 152 33

Name .....

Address .....

Please Print Clearly

City ..... State .....

panel in position and permit it to pivot on its axis.

The panel is kept rigid by a release pin formed from a piece of metal rod, a spring, and a radio knob. This is operated through a hole in the front edge of the bench. The compression spring keeps the release pin seated in a hole in the front edge of the panel.

Short 1/16- or ⅛-inch pins are set in the sides of the panel where they seat in depressions in the table surface and provide additional support. Grooves are cut in the sides of the hole—at the rear—to permit the panel to swing through 180 degrees.

The keying wires are run through one end of the tube and up through the center hole where they are connected in parallel to the two keys. It is here where the side pins prevent the panel from turning too far and eventually wringing off the wires as they pass into the tube.

With this idea it is a simple matter to pull out the retaining pin, swing the panel completely over and then let the pin back into place. A reverse motion is then necessary when the first side is to be brought uppermost. **L. B. ROBBINS**

FM STATION LIST

(Continued from page 73)

FREQUENCY (MC)	CALL	LOCATION
101.5	WJBC-FM	Bloomington, Ill.
101.5	WRAL-FM	Raleigh, N. Y.
101.5	WSPD-FM	Toledo, Ohio
101.7	KPNI	Palo Alto, Calif.
101.7	KWIL-FM	Albany, Ore.
101.7	WFAH-FM	Alliance, Ohio
101.7	WLIN-FM	Merrill, Wisc.
101.9	KARM-FM	Fresno, Calif.
101.9	KFXD-FM	Nampa, Idaho
101.9	WCTS	Cincinnati, Ohio
101.9	WGAN-FM	Portland, Maine
101.9	WGHF-FM	New York, N. Y.
101.9	WGNC-FM	Gastonia, N. C.
102.1	KSTP-FM	St. Paul, Minn.
102.1	WELL-FM	Battle Creek, Mich.
102.1	WEWS-FM	Cleveland, Ohio
102.1	WFIL-FM	Philadelphia, Pa.
102.3	WGAY-FM	Silver Spring, Md.
102.5	WFJS	Freeport, Ill.
102.5	WIBW-FM	Topeka, Kan.
102.5	WISE-FM	Asheville, N. C.
102.5	WOAI-FM	San Antonio, Texas
102.5	WNDR-FM	Syracuse, N. Y.
102.5	WPLH-FM	Huntington, W. Va.
102.7	KFMY	Fort Dodge, Iowa
102.7	KOKX-FM	Keokuk, Iowa
102.7	WAAT-FM	Newark, N. J.
102.7	WCAO-FM	Baltimore, Md.
102.7	WSMB-FM	New Orleans, La.
102.7	WTRI-FM	Troy, N. Y.
102.9	KFOR-FM	Lincoln, Nebr.
102.9	KPRC-FM	Houston, Texas
102.9	WCVS-FM	Springfield, Ill.
102.9	WFMU	Crawfordsville, Ind.
102.9	WLET	Toccoa, Ga.
102.9	WPEN-FM	Philadelphia, Pa.
102.9	WPIC-FM	Sharon, Pa.
102.9	WRLD-FM	Lanett, Ala.
103.1	KRJM	Santa Maria, Calif.
103.1	WCTW	New Castle, Ind.
103.1	WFMO-FM	Jersey City, N. J.
103.1	WJJW	Wyandotte, Mich.
103.1	WRGK	Brookfield, Ill.
103.1	WRGK	La Grange, Ill.
103.3	WDBQ	Dubuque, Iowa
103.3	WIZZ	Wilkes-Barre, Pa.
103.3	WLOG-FM	Logan, W. Va.
103.3	WSBA-FM	Montgomery, Ala.
103.3	WSFA-FM	York, Pa.

(Continued on page 80)

SURPLUS SPECIAL—Small 110 v. AC open frame motors, ⅛" shaft. 2700 R.P.M., 1/70 H.P., mfg. by BARBER COLEMAN CO. ..... $2.00 ea.

TRANS Pri. 200, 220, 240 V. 50 cy; Sec 75, 85, 95, 105 V.—1.5 A; Pri 195 V.A., Test 2000 V. $4.50

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1100 mfd. 50 volt 1.25
1500 mfd. 50 volt 1.65
2000 mfd. 50 volt 1.95
500 mfd. 200 v. 1.75

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Slide switch: Stackpole DPDT ..... .15
SPDT momentary, center off position, long bat handle ..... .29
4 pole DT 10A. 125 v. ..... .50
SPDT center off position, 6A. 125v. ..... .29
Toggle Bat Handle DPST ..... .35

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2 Gang 260 mmf per section -⅛" shaft, mycalex insul. 1.00
Condensers, Variable, Ceramic Insul. shaft 5/16x⅜" L.
C115-10-45 mmf with coil, tunes to 31 mcs .50
C122-7-27 mmf with coil, tunes to 58 mcs .50
C106-11-115 mmf ..... .35
15-330 mmf ¼" shaft Brass Plate, Ceramic .75
OIL Filled Condensers:
.03 mfd. 7500 v. DC 1.15
.30 mfd. 2000 v. DC ..... .65
1 mfd. 2500 v. DC 1.25
1 mfd. 1200 v. DC ..... .65
4 mfd. 2000 v. DC 2.75
10 mfd 1500v. DC 3.15

73 DE W2BOT

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Right Angle Adapter M359A ..... .30
7 Ft. Telescopic Ant. 1.00
Variable Ceramicon 4-30 mmf. 7-45 mmf. ..... .25
Filament Transformer: 5 volts @ 4 amp. 110 volt pri. open frame, porcelain standoffs, Mfd. by G.E. 1.50
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Pilot Light Assy. 1" Ruby jewel complete with 110 v. AC Candelabra base bulb ..... .50
12 v. Edwards' Buzzer complete with push button .40
Rectifier, Copper oxide. Full wave 110 VAC input, 100 VDC @ 1 amp. output 3.50
Solenoid, 6VDC Complete with plunger and mtg. Bracket 1.25
Microphone, T 17 with push to talk switch Cord and plug ..... .59
Sound powered phones, TS 10K (unused) Pr. 25.00
10-Point Jones Connector—Male & Female 1.00

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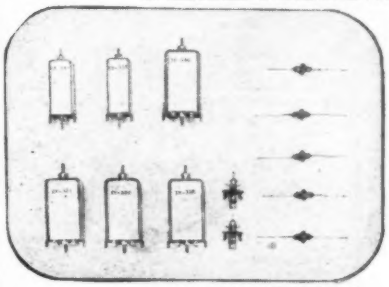

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- Antenna Coil
- Schematic Diagram
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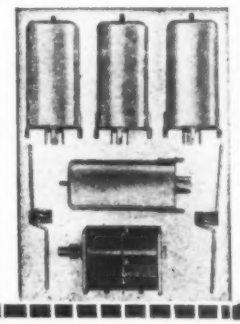

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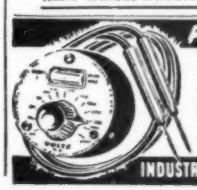

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Television network problems have now been solved, E. W. Engstrom of RCA laboratories told the Sigma Xi Society at Cornell University last month. Radio relays and co-axial lines have conquered technical obstacles and television is also well on the way toward solving its economic problems, he said.

New FM stations will go on the air at the average rate of 50 a month in 1948, the FM Association predicted in January.

FM STATION LIST

(Continued from page 79)

FREQUENCY (MC)	CALL	LOCATION
103.3	WSM-FM	Nashville, Tenn.
103.5	KYSM-FM	Mankato, Minn.
103.5	WSTV-FM	Steubenville, Ohio.
103.7	KQW-FM	San Francisco, Calif.
103.7	WROV-FM	Roanoke, Va.
103.7	WSAR-FM	Fall River, Mass.
103.7	WTBY-FM	Gadsen, Ala.
103.9	KENO-FM	Las Vegas, Nev.
103.9	KOPP-FM	Ogden, Utah.
103.9	WDLB-FM	Marshfield, Wisc.
103.9	WFAS-FM	White Plains, N. Y.
103.9	WJEM	Springfield, Ohio
103.9	WTAL-FM	Tallahassee, Fla.
103.9	WXNJ	Green Brook Twp., N. J.
103.9	WXNJ-FM	Plainfield, N. J.
104.1	KFUO-FM	St. Louis, Mo.
104.1	KMFM	Monroe, La.
104.1	WJW-FM	Cleveland, Ohio
104.1	WMUN	Muncie, Ind.
104.1	WSJS-FM	Winston-Salem, N. C.
104.3	KGNC-FM	Amarillo, Texas
104.3	KTOK-FM	Oklahoma City, Okla.
104.3	KWLK-FM	Longview, Wash.
104.3	WITH-FM	Baltimore, Md.
104.3	WLOS-FM	Asheville, N. C.
104.5	KIXL-FM	Dallas, Texas
104.5	KRCC	Richmond, Calif.
104.5	WHIS-FM	Bluefield, W. Va.
104.5	WWST-FM	Wooster, Ohio
104.7	WHVA	Poughkeepsie, N. Y.
104.7	WIST	Charlotte, N. C.
104.7	WJEJ-FM	Hagerstown, Md.
104.7	WOPT-FM	Oswego, N. Y.
104.9	KURV-FM	Edinburg, Texas
104.9	KONG	Alameda, Calif.
104.9	WMCK-FM	McKeesport, Pa.
105.1	KCLI	Los Angeles, Calif.
105.1	WDNC-FM	Durham, N. C.
105.1	WQDI	Quincy, Ill.
105.1	WFMJ-FM	Youngstown, Ohio
105.3	WWHG	Hornell, N. Y.
105.5	WFOB	Fostoria, Ohio
105.7	KIMV	Hutchinson, Kan.
105.7	KUOA-FM	Siloam Springs, Ark.
105.7	KXEL-FM	Waterloo, Iowa
105.7	WDAE-FM	Tampa, Fla.
105.7	WMBS-FM	Uniontown, Pa.
105.7	WRUN-FM	Rome, N. Y.
105.7	WSIC-FM	Statesville, N. C.
105.9	KFI-FM	Los Angeles, Calif.
105.9	KOMA-FM	Oklahoma City, Okla.
105.9	KSBS	Kansas City, Kan.
106.1	KGO-FM	San Francisco, Calif.
106.1	KIDO-FM	Boise, Idaho
106.1	WKJG-FM	Fort Wayne, Ind.
106.1	WKNP-FM	Corning, N. Y.
106.1	WLOB-FM	Claremont, N. H.
106.3	WMLN	Mt. Clemens, Mich.
106.5	WBEN-FM	Buffalo, N. Y.
106.5	WFML	Washington, Ind.
106.5	WRGA-FM	Rome, Ga.
106.5	WSTP-FM	Salisbury, S. C.
106.7	WGTM-FM	Wilson, N. C.
106.9	WMIT	Winston-Salem, N. C.
107.1	WAJL	Flint, Mich.
107.1	WCAP-FM	Asbury Park, N. J.
107.1	WWDX-FM	Paterson, N. J.
107.3	KSEO-FM	Durant, Okla.
107.3	WBNB	Beloit, Wisc.
107.7	KFSA-FM	Fort Smith, Ark.
107.7	WAYS-FM	Charlotte, N. C.
107.9	KXOA-FM	Sacramento, Calif.

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Electrolytic condensers 50-30, 150 Volt	10 for 2.89
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RADIO AS A VOCATION

(Continued from page 17)

yet he had a mentality of the highest caliber; and most of his knowledge was gained from books and publications.

In the final analysis, everything depends upon yourself. The more you know about a given subject, the more you specialize in it; and the more you know about it the greater are the chances that you will succeed.

Coupled with this, you require other qualities. It is, for instance, not enough that you are another Edison or a Marconi unless others know about your qualifications. The world, as a rule, does not run after you, *you must put yourself ahead;* in other words, you must know how to sell yourself to the radio industry. This can be accomplished only by bringing yourself to its attention, either by personal contact, by letter writing, or by writing for various radio publications and thus getting a reputation in the radio industry.

The radio industry is no different from any other, when it comes to manpower. Competition is just as keen in radio as it is in any other industry, and perhaps in many respects more so. It has, however, plenty of room for the young man of the right mental caliber. Every radio organization needs good men and is willing to pay their price; every organization needs specialists in their own line, men who can think for themselves, men who can do things, men with initiative, and men who believe in the future of radio. And after everything is said and done, always remember that radio is still in the earliest stage of its infancy; and that the young men who enter radio (and its legion of subdivisions) today, will "make" the great radio industry of tomorrow.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Radio-Craft	1929
Short-Wave Craft	1930
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

From the April, 1914 ELECTRICAL EXPERIMENTER

Sources of Energy for Radio Transmitters

Design and Construction Details of Radio Antennae by *H. Winfield Secor.*

Marconi Lights a Lamp Six Miles Away

A Simple Radio Break-In System by *J. W. Waite.*

An Adjustable High-Tension Condenser by *I. Rabi.*

Crystal Detectors on Parallel by *Alexander Polson.*

Lamp Test for Adjusting Detectors by *Arthur R. Darling.*

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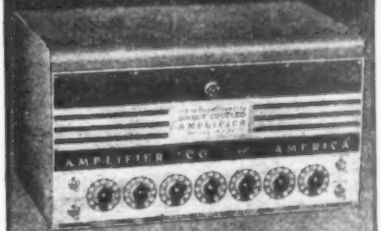

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Radio - Television - Electronic Parts & Equipment Specials

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The kits contain all the required parts except wire and solder for their construction into an efficient working unit comparable with the best post-war type of units.

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Tubes used: 1 - 12SA7, 1 - 12SQ7, 1 - 12SK7, 1 - 35Z5 and 1 - 50L6

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- For operation on 110 volt AC or DC and battery
- Superheterodyne circuit
- Full vision dial
- High gain loop
- Cabinet of Blue Aeroplane cloth finish, size 13x9¾x7"
- Tubes used 1A7, 1H5, 3Q5, 117Z6 and 2 - 1N5

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Bands covered BC 550-1600 KC and 6-18 MC

Power supply 105-125V AC, DC

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Variable condenser tuned, with two double tuned I. F.'s 455KC

Walnut veneer wood cabinet

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WRITE FOR CATALOGUE

RADIO DEALERS SUPPLY CO.

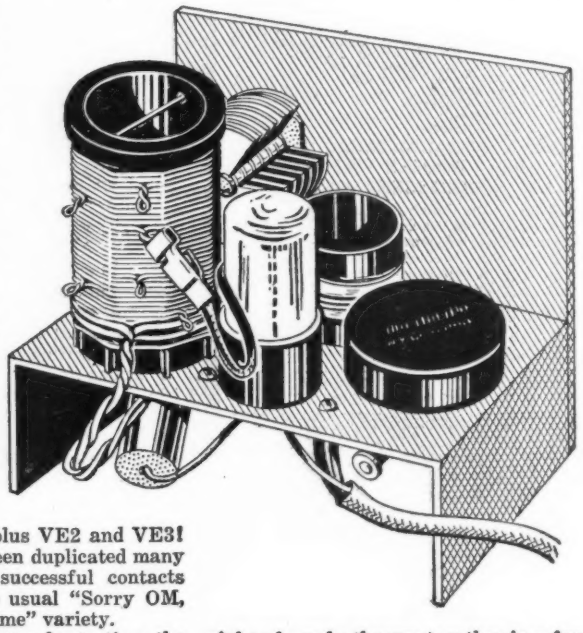
135 Liberty St. New York, N. Y.

5-WATT TRANSMITTER

(Continued from page 31)

shows a meter reading of 50 ma at 110 volts. A mere 5.5-watt input; but just take a few looks at Junior's record!

As an experiment, on a sultry July afternoon, a 15-foot piece of wire was attached to the rig and stretched down an upstairs hall. A W8 was raised, but the QSO was not completed. A W9, in Chicago, was also raised; this contact also fell through, but not before Junior had been given a signal report of RST 5-8-9X! With a 132-foot antenna, working against ground, the little rig has worked (from Baltimore) about 20 states in the following districts: W1, W2, W3, W8, W9, and WØ, plus VE2 and VE3! These QSO's have been duplicated many times, some being successful contacts and some being the usual "Sorry OM, QRM got you that time" variety.



(Sent to RADIO-CRAFT for testing, the little transmitter was set up in the Bronx, and worked W3, W8, W9, and—crown of the evening—G2! Tests were stopped immediately. T9 note was reported on most contacts, though the note can be spoiled by tuning the output too close to the crystal frequency.—*Editor)*

And all this with a transmitter that uses less than five dollars worth of material and can be thrown together in a few hours by any reasonably adept ham! Cost is not the only advantage, either. With more attention to compactness, this would make an ideal rig for vacationing amateurs, fitting in a corner of the suitcase.

Considering expenditure and results, this 5-watter is a really useful addition to *any* ham shack, whether the operator is a beginner or an old timer. Give Junior a whirl some frosty winter night, and you'll forever rue the day that you started buying high-power transformers and bottles. Unless, that is, you prefer brawn to brains. And some *do!*

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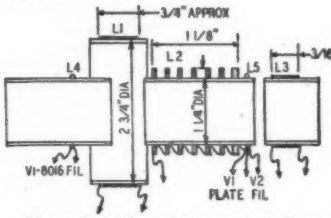
HIGH-VOLTAGE R.F. COILS

The experimenter who wishes to construct an r.f. high-voltage generator, such as described in the May, 1947, issue of RADIO-CRAFT, can make the coils without a coil-winding machine by winding the wire on spider-web forms cut out of thin composition board or heavy stencil paper, both of which are available in art supply stores. (Excellent forms for this purpose could be cut from polystyrene sheets.—*Editor)*

In cutting and winding the forms the inside dimensions and the number of turns given in the original descriptions should be followed. The layers may be spaced with nuts or spacing washers from a discarded condenser. The screw holding the forms together should be brass.



My original coil forms had 7 sections, but the coils will be flatter and neater if a larger number of sections are cut, at least 11 or 13. The forms *must* be cut with an odd number of sections.

Coil forms of this type will take up much more space than the conventional type, but the experimenter can try smaller diameter forms and more layers. With this arrangement, it pays to experiment with the number of turns in the grid coil.

Coils of this type may not be as efficient as those of modern design, but they can be made without special equipment.

Incidentally, for those who do not have a beam-power tube handy, other tubes will work. I used a 59. It operates more efficiently as a triode, with the control and screen grids tied together and the suppressor grid connected to the plate. I found a low value of grid resistor gave best results.

HAROLD WALKER,
Philadelphia, Penna.

A STABLE REGENERATIVE RECEIVER

(Continued from page 34)

to the speaker voice coil. The output terminals are brought out to the rear of the chassis. Inserting the headphone plug in the jack silences the speaker.

A small a.c.-d.c. choke may be used in place of the 450-ohm resistor in the power supply.

Since the set uses an a.c.-d.c. power supply, take care not to ground the chassis. A 1-ampere fuse in the line is sufficient protection in case of an accidental short circuit.

If you have wondered what a good regenerative receiver is capable of doing try building this one. The results are really worthwhile. It is no temperamental plaything, but a receiver you will enjoy listening to and operating.

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Operates on 110-120 volts AC/DC. Contains everything you need. Instruction Book, Metal Chassis, Tubes, Condensers, Resistors and all other necessary radio parts. The 36-page Instruction Book written by expert radio instructors and engineers teaches you to build radios in a professional manner. The first circuit built is a simple one-tube detector receiver. Each succeeding circuit incorporates new arrangements of detectors, RF and AF amplifiers. This kit is excellent for learning the principles of receiver, transmitter and amplifier design. It is used in many radio schools and colleges. All of the commonly-used detectors are used, including diode, grid leak, plate and infinite-impedance. The transmitters are designed with Hartley and Armstrong oscillators, using screen-grid and control-grid modulation. Both vacuum tube and selenium rectification are employed in these circuits. The circuits are designed to provide excellent performances. Altogether, fifteen circuits are constructed, including 11 receivers, 1 audio amplifier, and 3 transmitters. The sets start with simple circuits of 1 tube plus rectifier, gradually grow more complex, and finish with several examples of radio sets using three tubes plus rectifier.

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Designed for operation on 88-108 MC (new band), contains 2 IF transformers, 1 Limiter Transformer, 1 Discriminator Transformer, 1 RF coil, 1 Variable condenser, Schematic and wiring instructions. Excellent for schools, experimenters and Radio Hobbyists. Price only $4.95

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50 Paper Tubular Condensers. Values from .002 mfd to .1 mfd. 400 V. DC to 600 V. DC. Only $1.95

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100 Carbon Resistors, ½ Watt., RMA color-coded. Values from 120 ohms to 2.2 megohms $1.50

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HIGH FIDELITY, HUMLESS, AMPLIFIER. SEVEN TUBE PEFORMANCE
This newest Progressive Kit will enable you to build a newly-designed, high fidelity, humless amplifier.
Beautiful aluminum custom-punched chassis, etched tone and volume control plates.
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Ideal amplifier for television kit or set, FM tuner, AM tuner, microphone, phonograph, wire and instantaneous recorders.
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Nearly 200 million receiving tubes were sold by member companies of the RMA in 1947, that association reported last month.

Of the year's total of 199,584,827 tubes, more than 2/3 were sold for new sets, and approximately 1/10 for replacement purposes. The remainder were sold for export and to government agencies.

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4 LAMPS ELECTRONIC PHOTO FLASH EQUIPMENT. THE FAMOUS "MODEL 1503" AIRCRAFT FLASH UNIT.

This powerful high quality equipment was made for the U. S. Aircorps and will be shipped to you brand new in original boxes.

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- **THE FOUR HIGH SPEED FLASH TUBES** are plastic sealed, unbreakable, 12 million peak lumes light output for more than 15,000 flashes.
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100 assorted carbon and wirewound resistors . . . ½ to 10 watt. Wide range of values. All standard items.

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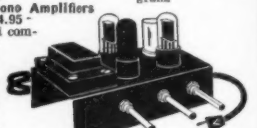
50 assorted paper and mica condensers. . . All new . . . Good value.

Wireless Phono Oscillator $4.52
Operates as far as 100 feet from radio and can be used with automatic record changer and players . . . complete with 2 tubes all wired and tested. Diagram.

Mike and Phono Amplifiers $14.95
This unit sold complete with power transformer, 2 tubes and 3 controls . . . all wired and tested. Diagrams supplied.



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Super-het circuit, 5 tubes, 4" Alnico 5 speaker . . . complete with bakelite cabinet, tubes, and instructions.

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Operates on self contained "B" and "A" batteries . . . broadcast 550 to 1600 Kc. Has 4 tube super-het circuit . . . Complete with tubes, case and instructions . . . Batteries extra, $1.75.

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6" PM Speaker with 50L6 output	1.90
5" 450 ohm dynamic speaker with 50L6 output	2.39
Selenium Rect. Boxed, 100 Ma.	.69
½ meg. Volume Controls and Sw. long shaft	.35
6 ft. line cord	.13
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Communications

WANTS STRAIGHTFORWARD CIRCUITS ONLY

Dear Editor:

James R. Langham's article, "Adventures in High Fidelity" was a *wow*. I have not yet made up my mind as to whether I ought to sue you for injuries to my laughing gear. I am old-fashioned in my ideas on the requirements and tubes for quality amplifiers. Have nothing but Bronx cheers for feed-back, Ring-around-the-Rosy circuits when a plain class-A 1- to 5-watt amplifier is more than enough to blow speakers and drive a good recording head.

I am a fall guy for such articles as "Build Your Own Recording Studios," etc. The more I read the more confused I become, what with the 3 different reference levels, the K's *vs* the M's, the condenser markings and the different recording characteristics, which are ridiculous and change overnight.

I took up a general discussion of these matters with an expert "record jockey" at NBC in New York City, a while ago, and it ended in his telling me that I should take a recording course and get modern ideas. Looking around, I found a school over in Jersey. I was dumfounded at the vast number of tubes in the amplifiers to drive the 2 recording heads on a pair of small recorders which looked like the machines the late Thomas Edison used to work with.

The instructor turned on the amplifiers and a swell 200-horsepower howl started up. He then explained he had forgotten to close the studio door. I backed out and have given up the idea of becoming modernized on sound. I am going back to Western Electric's principles and systems, except the up-and-down recording.

Let's have a few more nonsensically sensible articles by Mr. Langham.

RALPH W. NICHOLS,
Miami Shores, Florida

COSMO-COMPO RADIOS WILL RUIN SERVICEMEN?

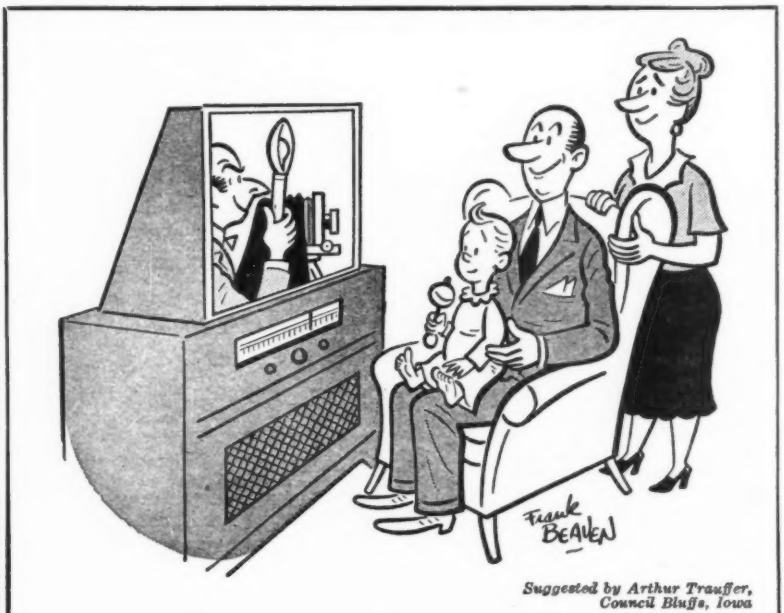
Dear Editor:

Your December, 1947, RADIO-CRAFT has an article on the new *Cosmo-Compo* radio.

The heading of the article reads: *This Radio Services Itself*. Above it is a hand holding a soldering iron. What is of the gravest importance to every serviceman is *the cross that cancels that figure out*. That cross means the cancellation of the efforts made by every serviceman now in business, those who are still learning to read diagrams and those who have spent years learning how to do an artistic, neat, and complicated job of wiring.

The only thing this new idea has done is to make it possible for the customers to take the profit out of the servicing profession. This means that the good old American way of life, which carries with it security, education, better economic conditions and luxuries, will soon be only a dream for the serviceman.

This smart idea coming on the market means that the art of radio serv-



Suggested by Arthur Trauffer, Council Bluffs, Iowa

icing returns to the days when any *jack-out-of-the-box* with a nail file and a pair of pliers, was a radio repairman. This radio would cause all the hours of work and hard study, and the many dollars for test equipment, to have been spent in vain. And all the labor and time spent in developing a successful servicing business would also be wasted.

With this type of radio the public would be able to make *any repair* the same as if only a tube were out. Why not let the radio profession stay out of the hands of the novice? Let him change tubes, but don't make it possible for him to replace any stage of his set that may be dead.

Radio servicing is a proud profession for those who are in it, and can still be the idol that catches the eyes and interest of many to come. It will cease to be such if there are no profits in it for the poor serviceman who even now finds it hard to meet his bills. The radio serviceman is a human being, and is entitled to win his bread the same as anyone else. He has to buy food, clothing, shelter, and all the things that are necessary for a decent life. They should not be cut off just because someone has perfected an idea that will put him on Easy Street.

KENDALL W. WILLIAMS,
Xenia, Ohio

(Even if it were true that this invention might make it necessary for some radio technicians to seek new jobs, that would be no argument against it. Would our correspondent wish us to still ride horseback to work? In fact, if his ideas were followed, we would have no radios to repair, as the earlier inventors of electrical equipment would have been prevented from throwing the artisans in older crafts out of work.

But it is not true. The wagon makers Studebaker and Fisher, for example, did not starve to death with the invention of the motor-driven vehicle, but prospered as manufacturers of automobiles and motor car bodies, respectively. The intelligent radio technician will progress and prosper with improvements in the technique.

It is, of course, not entirely certain that this new technique will prove technically and economically superior to present methods of production and servicing. *All the more reason for the serviceman to keep alert!—Editor)*

WANTS FEDERAL SERVICEMAN'S LICENSE

Dear Editor:

I want to add a few words to the subject: Should servicemen be licensed?

I think that the serviceman should be licensed by the Federal Government and that licensing requirements should be uniform for the whole country. The serviceman could post this federal license in his shop to prove to his customers that he knows his business.

The examination should be similar to the radio operator license examinations except that it should be devoted to questions on radio servicing. The license should be issued free after the serviceman passes the test.

The licenses could be of different classes: one type would be for the learner, or the fellow just starting out in servicing; another class would be for the man with a fairly good knowledge of servicing; and a third class for the all-around serviceman with experience in FM and television. There could be also a separate license for sound-system technicians.

A board of radio engineers and servicemen could be set up to determine the nature of the examination questions.

The Government should not regulate wages or charges for servicing, because rates vary in different parts of the country.

I believe that this licensing would obviate any comment from the public about underhanded dealings in the radio servicing industry.

HERBERT C. TAYLOR,
Keysville, Virginia

A COMBINATION CODE TEACHER

This interesting code teacher uses a disc of the old Omnigraph type which sets up any one of four tones, works a mechanical key to give the student the "feel" of the code, projects dots and dashes on a transparent dial and flashes a blinker at the same time. By thus co-ordinating all the senses, learning time is cut down, reports Harold Herman of Chicago, its constructor.

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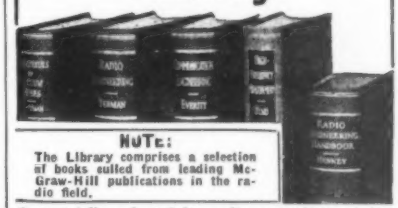

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BOOK REVIEWS

AN APPROACH TO RADIO, by J. B. Shrewsbury. Published by Electronic Industries. Stiff cloth covers, 6¼ x 9 inches, 288 pages. Price $4.50.

The author has written this book to present radio theory in a very simple and non-technical manner. It gives the necessary information to the beginner to permit him to approach a more detailed study of radio.

The book is divided into eight chapters covering receivers, audio oscillators and amplifiers, and transmitters. There are many drawings and schematics throughout the book and information is given for the construction of simple receivers.

PATENT NOTES FOR ENGINEERS, prepared and edited by C. D. Tuska and other members of the patent Department of RCA Laboratories. Published by RCA Review. Stiff cloth covers, 6 x 9¼ inches, 165 pages. Price $2.50.

The material in this book was prepared primarily for use by the patent department of RCA Laboratories. However, inventors, research groups and engineers will find its contents useful in obtaining a better understanding of patent terminology and the problems of the inventor and the patent attorney.

The book clearly defines an invention and sets forth the requirements of a patentable invention. A number of citations or case records have been included to show some of the problems that may be met by the inventor. It is worth a place on the bookshelf of all persons engaged in research and development work.—*R.F.S.*

HOWARD W. SAMS DIAL CORD STRINGING GUIDE, compiled and published by Howard W. Sams & Company. Heavy paper covers, 5½ x 8¼ inches, 112 pages (not numbered). Price 75 cents.

A collection of 522 diagrams showing how to string dials on most popular radios. Since often a number of receivers have an identical dial-stringing system, the diagrams are useful for far more than 522 sets. With a complete index and an introductory chapter on dial-stringing.

AUSTRALIAN SHORT WAVE HANDBOOK, edited by John Moyle, VK2JU. Published by Associated Newspapers Pty. Ltd. Paper covers, 8 x 11¼ inches, 120 pages. Price 2 shillings (Australian).

This handbook of radio call signs and short wave technique was prepared for the Australian radio amateur and set builder. It begins with a short introduction to short waves and includes hints on receiving conditions and on obtaining short wave verification or QSL cards. Its second chapter is a listing of Australian commercial and amateur radio stations.

The remainder of the book includes circuits and construction details on receivers, transmitters, antennas, and modulators. This material, reprinted from *Radio and Hobbies* (Australia), is of interest to any radio experimenter or amateur.—*R.F.S.*

UNDERSTANDING VECTORS AND PHASE, by John F. Rider and Seymour D. Uslan. Published by John F. Rider. Flexible fiber covers, 5¼ x 7 inches, 153 pages. Price 99 cents.

A book for the radio serviceman, this is an excellent example of what can be done by the practical writer for the practical reader. The authors realized that vectors are inherently far simpler than much of the mathematics traditionally taught as preparation to their study, and have produced a book which can be understood by any radioman with a knowledge of arithmetic and simple geometry.

Methods of handling vectors and calculating impedance, reactance and resistance in circuits containing various combinations of resistors and reactors are clearly explained. Incidentally, many radio servicemen will find in this book their first understandable exposition of the FM discriminator.

RADAR BEACONS, edited by Arthur Roberts. Published by McGraw-Hill Book Co. Stiff cloth covers, 6½ x 9¼ inches, 489 pages. Price $6.00.

This book is Volume 3 in the M.I.T. Radiation Laboratory Series. The equipment and systems described in it, however, are the collective result of work done in the United States, England, Canada, and other countries.

The book is divided into four parts. The first discusses the nature of radar beacons and the principles on which beacon systems are designed. The second section deals with the design of radar beacons, covering r.f. components and circuits in beacon systems.

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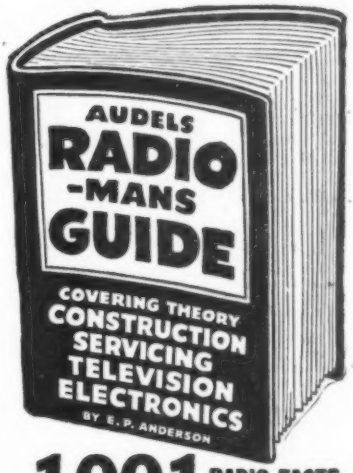

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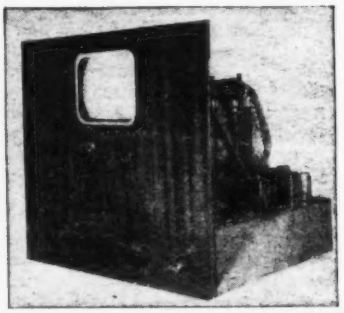

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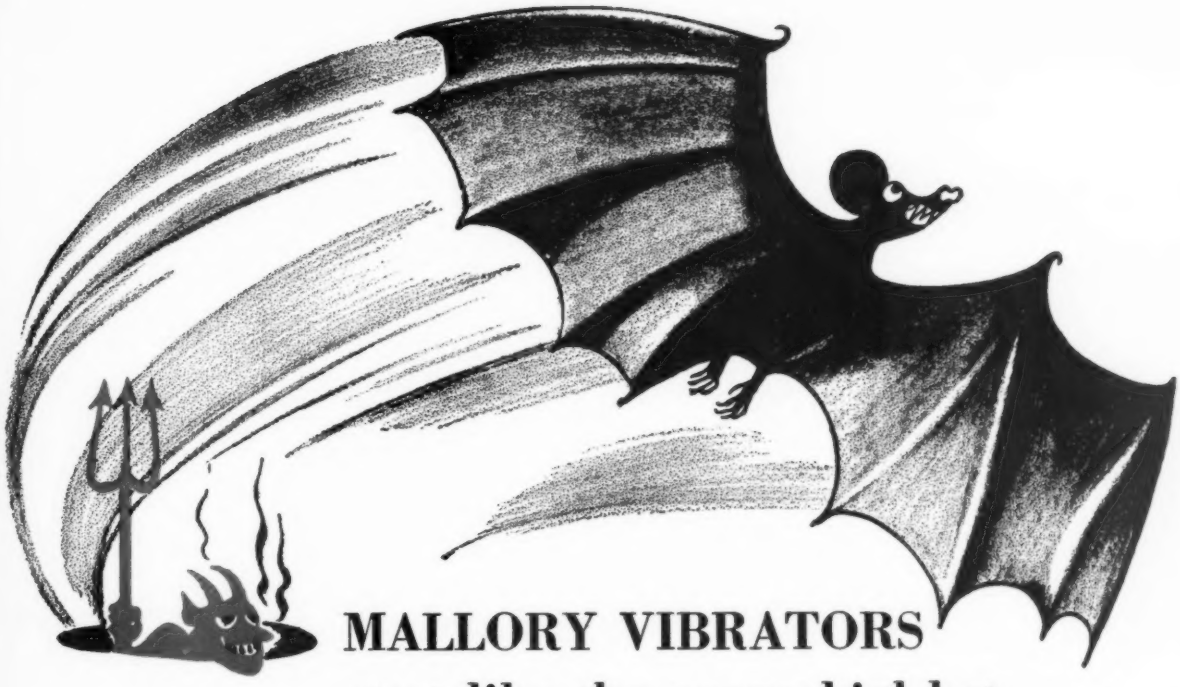

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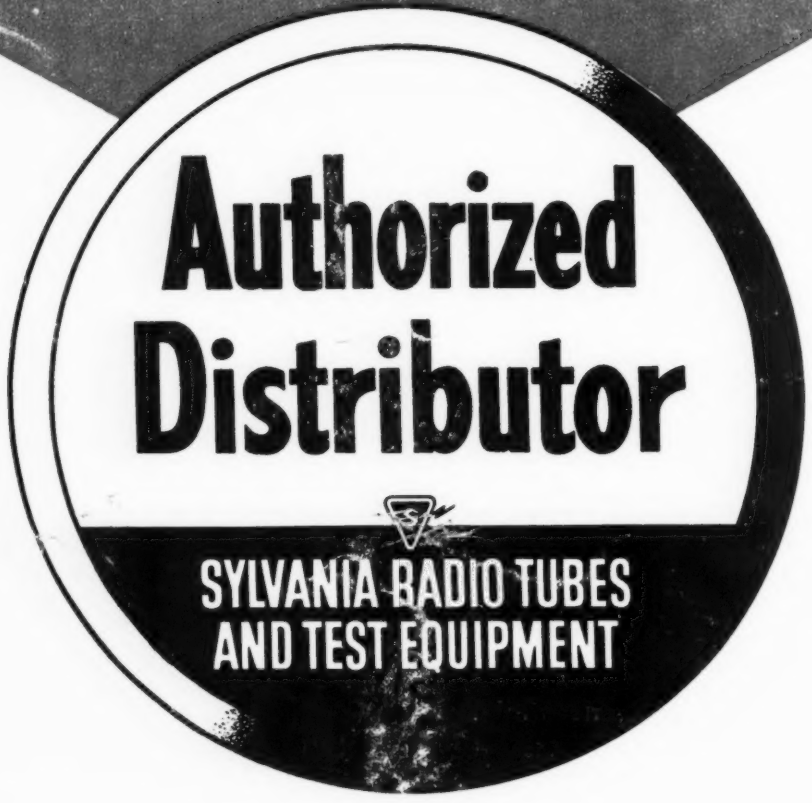
VIBRAPACK® POWER SUPPLIES . . . FILTERS

®Reg. U.S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Look for the distributor who displays this sign!



AS a part of its 1948 program, Sylvania Electric will supply each of its authorized distributors with this new decal, printed in red, yellow, black and three shades of green. It's worth your while to look for this sign on his windows, doors and trucks — it is your assurance that this distributor will supply you with genuine Sylvania radio tubes and top-quality test equipment — and that you can count on prompt, courteous service as well!

Sylvania Electric Products Inc., Radio Tube Division, Emporium, Pa.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS